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A SHORT HISTORY

of the

INDIANA STATE HIGHWAY COMMISSION

By J. M. HENRY,

Formerly Office Engineer for the Indiana State Highway Commission.

Resigned August 24, 1925, in protest against the removal of C. Gray as Chief Engineer.

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2445 N. Delaware Street
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INDIANA

PREFACE

For several years the Indiana State Highway Commission has been the subject of controversy. In the 74th General Assembly, 1925, a bill was introduced to give the Chief Executive of the State authority to revise the personnel of the Commission but it was charged with being a political measure, was labeled the "ripper bill" and was smothered by dubious methods.

Since that time the Commission has been frequently in the public prints. Indictments have been voted by the grand jury against one of the Commissioners and the Director. The State Board of Accounts has rendered a report showing millions of dollars of government property disposed of without adequate compensation.

Still the Board continues to function and many of the newspapers of the state still defend the Commission on the theory that all attacks are a political attempt to gain control of patronage.

This short history of the Commission and its activities is published in order that there may be readily available for those interested, the facts involved in this much controverted subject.

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SUMMARY

A State Highway System is believed to be essential.

The present Highway Commission Law is adequate, but should fix responsibility for inefficiency and malfeasance.

The Administration of the present Highway Commission has been inefficient, under political control, granting favors to favorites, wasteful of funds, and expensive in overhead.

Sales of Federal property have been made without proper accounting or safeguards. Pay rolls have been padded. Results accomplished have been out of proportion to the immense sums that have been expended.

The misdeeds of the Commission have been covered up by campaigns of denunciation against county and township officials, whose offenses, if any, were lack of funds.

There seems a lack of executive responsibility in the present management of the Commission affairs. The remedy is a cleaning out of the present personnel of the Commission and of its inefficient employees.

There should be appointed instead, honest men of high reputation, who would refuse to permit the building and maintenance of state highways at an expense of ten to fifteen million dollars a year, to be made the tool of politicians and material men.

The Governor of Indiana should be called upon to remedy the condition. Otherwise the 75th General Assembly should enact legislation that will provide for executive responsibility.

A Short History of the Indiana State Highway Commission

CHAPTER I

The state of Indiana has approximately eighty thousand miles of streets and highways. The State is 160 miles wide and 240 miles long with about 36,000 square miles of area. If each square mile were bounded by a highway, that is all section lines used as roads, the total mileage of highways would be 72,000. Many section lines do not have roads, but city streets and diagonal highways substantially compensate.

Prior to 1917 these highways and streets were built and maintained by the counties, townships, and cities in which they were located. With an abundance of gravel available in the northern part of the State and crushed stone plentiful in the southern part, the roads and streets have been surfaced principally with these materials. Heavy traffic streets in cities were paved with asphalt or brick or some other hard surfaced pavement.

Gravel roads were built at a cost of $1,500 to $3,000 per mile and crushed stone was only slightly more expensive. To maintain such roads in the way that it was formerly done by the local officials cost from $50.00 to $100.00 a mile per year. Assuming that these roadways were sixteen feet wide, the former standard country highway width, the cost of construction would be at the rate of 20 to 40c per square yard and maintenance at a cost of 1c per square yard per year.

The cost of city streets is much higher. Asphalt and brick require a concrete foundation and cost $3.00 to $4.00 a square yard for construction and endure for perhaps 15 to 20 years for asphalt and 25 to 30 for brick. Wooden block is even more expensive. Concrete is relatively cheaper, perhaps $2.50 a square yard but with a shorter life under heavy traffic.

The popularity of the automobile created a demand for better roads, and this demand has culminated in a policy of building heavy traffic country highways of substantially the same quality as was formerly required for city streets. This has resulted in paving our main highways with concrete, asphalt or brick, doing away with gravel and stone. The reason is not only that modern traffic demands a smooth pavement but the gravel and crushed stone pavements when subjected to heavy wear, become so dusty that it is almost impossible to keep them in repair. In short, the cost of maintenance becomes prohibitive and necessitates a harder surface at a higher first cost.

There is no such thing as a permanent pavement. All road and street surfaces are subject to wear. The best that can be expected of them is that they will stand up under heavy traffic for a period of years, and it is the province of the road engineer to fit the pavement to the traffic so that the interest on the first cost plus the depreciation will be less than the cost of maintenance of cheaper surfaces. That is to say, if the cost of maintaining gravel is greater than the interest and depreciation

of a hard surface, then the hard surface will in the long run be the more economical. Added to this of course, should be the greater ease of transportation on the harder surface, although this element has been greatly over rated by good roads enthusiasts.

Because of the supplies of crushed stone and gravel readily available, Indiana was slow to adopt legislation creating a highway commission. Reports of the United States Department of Agriculture showed Indiana with 40% of its roads surfaced when Iowa had but two per cent as late as ten years ago. Yet Iowa was one of the first States to have a Highway Commission, created in 1904. Some eastern states as Massachusetts had preceded her and were early building hard surfaced roads.

Illinois adopted the highway commission policy in 1906. The people of Illinois have been led to believe that bonds for road construction can be paid with the taxes collected from automobiles and gasoline. But Illinois never had the gravel and stone roads that had made Indiana highways nearly half available for traffic even in bad weather. Illinois roads were mud roads. They are being rapidly converted into concrete surfaced highways by bond issue. The State of New York followed a similar policy years ago, but later abandoned the concrete highways for more permanent forms because it found that its bond issue funds were no sooner expended than it became necessary to rebuild the highways which had worn out under the heavy traffic.

Every state in the union now has a highway commission. It is admitted everywhere that the volume of traffic now flowing on our main highways calls for a different kind of supervision from that of the former farm traffic on gravel roads. The first Indiana Highway Commission law was passed in 1917, and was shortly afterwards held unconstitutional. In 1919 the present law was passed, and under this law a system of state highways has been created consisting of about 5,000 miles of inter-county roads. This is approximately 7% of the total road mileage of Indiana.

A large part of this 5,000 miles still consists of gravel and crushed stone road surfaces and approximately one-fourth of the expenditures of the Highway Commission are devoted to maintaining them, at a cost of from 500 to 1,000 dollars a mile per year. Contrast this with the former 50 to 100 dollars per mile per year under the county and township system. Where traffic is too heavy for gravel or crushed stone, concrete, or other hard surface is built, now at a cost of $30,000 to $50,000 a mile where the former gravel road costs were $1,500 to $3,000. Although the value of the dollar is now less, the ratio for the adjusted dollar would be seven to twelve times the earlier cost.

The remaining 70,000 miles of roads, not including streets, are still being maintained and built under the supervision of the county, and township officials. The State Highway Commission has nothing to do with them except occasionally on petition to supply inspection or approval of plans at the cost of the local government subdivision paid to the Commission.

The source of funds for this maintenance and construction by the State Highway Commission rests largely in special taxes on gasoline, license fees, Federal Aid funds from the United States Government, formerly general and inheritance taxes; altogether there has been received and disbursed by the Highway Commission up to September 30, 1925, a total of approximately $57,000,000.00. With this fund the State Highway Commission has kept in repair an average of 3,600 miles, and has built on our proposed State Highway system: 792 miles of hard surfaced pavement, 37 miles of gravel, 16 miles of crushed stone, and about one mile of grading not surfaced. The present year adds $15,000,000 more to the expenditures with about 200 miles added to the total.

The Director, in the annual report of the State Highway Commission for 1925, page 6, shows the average cost per mile of road, including grading, small structures, and pavement, as built by the construction department, to be $26,333.57. In arriving at this average, he has only included the amounts paid to contractors, but this is by no means the total cost. The report of the construction department, page 35, shows "Amounts Paid to Contractors on Federal Aid Roads" during the fiscal year as $5,562,740.71, and on page 36, the same item for State Aid Roads is given as $63,035.17, or a total of $5,625,775.88 for contract payments alone.

To this amount must be added the cost of cement including freight, as furnished and paid for by the Commission. On page 28, a tabulation of the construction department figures shows the cost of cement, plus freight charges, as $2,056,354.72 with a refund for cement sacks, etc., of $315,614.64, or a net cost of $1,740,740.08 for cement. Again to this must be added the cost of engineering and inspection which enters into the cost of the work. The Director shows, page 7 of the same report, a charge of $107,033.39 for engineering and inspection costs on Federal Aid roads, and $2,058.82 on State Aid Roads, but he leaves out entirely the cost of surveys and and plans on these roads, which must also be included in making a fair average of mileage costs.

Thus, when all these items are added to the "Contract Payments" (which is the only cost that the Director shows) the following is the result of the Road Department activities for 1925:

Total paid to contractors, Federal Aid	$5,562,740.71
Total paid to contractors, State Aid	63,035.17
	$5,625,775.88
Cost of cement	1,740,740.08
Engineering and inspection costs, Federal Aid	107,033.39
Engineering and inspection costs, State Aid	2,058.82
Plan and survey costs, Federal Aid	47,351.00
Plan and survey costs, State Aid	1,209.13
Grand Total	$7,524,168.30

The report shows completed during the year 203 miles of hard surfaced roads, 6 miles of gravel, and 16 miles of crushed stone, or a total of 225 miles. For the sake of comparison, if the crushed stone and gravel be considered on an equal basis with the hard surface roads, the average cost per mile is $33,292.78 instead of $26,333.57, as shown by the Director.

The foregoing figures show the actual costs chargeable to the projects under way during the fiscal year, but do not include the vast expenditures for Administration, Garage costs, etc., all of which must be counted as part of the overhead cost by reason of the fact that these charges are all incident to the road construction and maintenance program. If it were not for the repair and upkeep of the hundreds of cars and trucks operated by the Commission, the State would have no need for a central garage in Indianapolis and thirty-three sub-garages throughout the State, in which approximately $1,000,000 is expended yearly.

All of this should have been considered in summing up costs. The annual report for 1925 shows an expenditure of $3,775,-391.92 by the maintenance department, or an average of $957.26 per mile, which does *not* include the proportionate share of cost of the Equipment Division in supplying and maintaining the enormous fleet of cars, trucks, and trailers used by the Maintenance Department.

If this expenditure be all that is properly chargeable to maintenance, as the report of the Director shows, then there remains a balance of $10,742,402.26 of the 1925 expenditures and if this is chargeable to the construction of the total of 225 miles of road as shown by the report, including 22 miles of macadam and gravel which are very short lived under modern traffic, then the taxpayers of Indiana paid approximately $47,500.00 per mile for their new state highways in 1925, instead of $26,333.57 reported by the Director. And if the total of expenditures be distributed over the total of hard surfaced pavements, we find $72,000,000 expended for a net result of 1,000 miles of pavement or an average of $72,000 per mile.

This average cost per mile of new roads grows higher with each succeeding year. The funds come easily through indirect taxation, provided by a liberal legislature urged to action by automobile organizations. The policy of the Commission seems to be "Easy come, easy go." In this the public so far has concurred. What matters the few cents added to a gallon of gasoline. But, viewed from the standpoint of results, it is of tremendous importance to every one of us that our highways are not being completed, that the funds are being wasted, and that, judged by past accomplishments, it is going to cost $300,000,000 more to complete the 7% of our highways that constitute our State system, and that thirty years will be required to do it. By that time we shall be under the necessity of replacing the roads first built and thus we shall have a never-ending burden to support.

(*To be continued*)

A Short History of the Indiana State Highway Commission

(Continued from Chapter I)

CHAPTER II

The present highway commission law was passed in 1919 and Governor Goodrich appointed on April 18, 1919, D. C. Jenkins to serve one year, John T. Oliphant to serve two years, Earl Crawford to serve three years, and Archy Campbell to serve four years. D. C. Jenkins was made chairman. The Board appointed L. H. Wright director and H. K. Bishop, chief engineer of construction. Chesleigh Gray was made chief of the Bureau of Contracts; W. J. Titus, chief of the Bureau of Bridges, and Fred Kellam, acting chief of the Bureau of Tests.

L. H. Wright was made director because he had been a hard worker with the Legislature for the passage of the bill creating the Highway Commission. H. K. Bishop was an able and skillful engineer who had given long service to the Federal Government as district engineer of highways. W. J. Titus had formerly been employed by Daniel B. Luten, bridge engineer, with experience in concrete bridge design.

In April, 1920, the Maintenance Division was organized with A. H. Hinkle in charge. Mr. Hinkle was formerly with the Ohio State Highway Commission and had long experience in highway maintenance in that state. Fred Kellam was then made Chief of the Bureau of Tests. On the expiration of the one-year term of D. C. Jenkins, Governor Goodrich appointed Chas. W. Zeigler of Attica for four years, and Archie Campbell was elected chairman of the Board for the year 1920.

With the coming of Chas W. Zeigler to the Board occurred one of the first of the acts for which the Commission has been blamed. The counties of Fountain and Warren proposed to build a joint county bridge across the Wabash River at Attica. Through the influence of Zeigler part of the engineering force of the Highway Commission was loaned to the county for the design and supervision of the bridge. There was no provision in the law for any such arrangement and it resulted in the expenditure of considerable amounts of state funds for the benefit of Mr. Zeigler's home county without any legal right.

The contract for erection was taken by a Chicago firm which failed to complete the contract although it received the award at a bid much higher than the lowest bid. It was found impossible at that time to sell the bonds to build the bridge because the rate of interest was not sufficiently high to accomplish the sale above par. The state funds were again drawn upon by Director Wright to the extent of over $19,000 to make up the deficiency. Realizing that such an appropriation by the state of its funds was illegal Director Wright and Bridge Engineer Titus falsified the records and made the voucher show that the sum was spent

for materials purchased by the state from the contractor. Chesleigh Gray's name as chief engineer was signed to the voucher for $19,000 without his consent.

All of these facts were subsequently disclosed by an investigation by the State Board of Accounts which reported them to Governor McCray. To further conceal and repair the bad record made in this case the Highway Commission later took over as part of the state system, the road on which the Attica bridge was built. This would tend to offset any charge that might be made that state funds were being used illegally to aid certain counties to the disadvantage of others. The policy of favoritism thus inaugurated for the benefit of Zeigler's county has been persisted in throughout the history of the Commission since that time.

To bring this in on a state road, the road north from Terre Haute which would ordinarily have crossed the river into Clinton and then continued straight north to Kentland, was diverted northeast below Clinton to pass through Rockville, on a new right of way costing $200,000 and at a total expense of about $2,000,000 to pass through Attica and thence north and west to Kentland. By passing through Attica it crossed the Wabash on the new bridge and further benefited the home city and county of Chairman Zeigler to the disadvantage of Vermillion and Warren counties through which the road should have gone in a direct line to Kentland from Terre Haute on the way to Chicago. Further details and a map of this detour will be given in a subsequent chapter.

The investigation by the State Board of Accounts in the Attica bridge matter led to other exposures of improper use of funds. It was found that Director Wright, who was also secretary of the Aetna Trust Company of Indianapolis, was keeping funds of the Highway Commission on deposit in this trust company under his own name, much to the advantage of the trust company. This exposure created such a scandal that Mr. Wright's resignation was demanded and he was relieved of the position. Any taxpayer of Indiana could probably recover for the state from Wright and Titus, and from Zeigler and Crawford, the sums of upwards of $19,000 paid by the state on their approval, made without any legal right.

This Attica bridge moreover was designed with its foundations in gravel, and subject to heavy floods which may cause serious scour and undermining of piers and abutments. In such circumstances it is good engineering practice to design so that all of the load will be carried by the piling foundations of heavy timbers driven deep into the gravel. The Meridian Street bridge at Indianapolis was designed with its footings 12 feet below the level of Fall Creek but in gravel, and it was undermined and wrecked, and had to be rebuilt at a cost of about $150,000. In the case of the Attica bridge, the Bridge Department did not design it to carry the full load on the timber piling, but part of

the load of the bridge itself is to be carried by the gravel bed. If this should wash away in a heavy flood, the bridge might fail. It is inadequately designed for its location.

Before all these difficulties had been created by the misbehavior of Director Wright, he had, under pretext of saving the salary of $6,000 a year, asked for the resignation of Mr. Bishop as chief engineer. Mr. Wright appointed Chesleigh Gray to succeed Mr. Bishop, and when Mr. Wright resigned he was succeeded by Lawrence F. Lyons. When Oliphant's term expired in 1921, Governor McCray appointed W. G. Zahrt for four years. Upon the expiration of Crawford's term in 1922, he was reappointed by Governor McCray for four years, after which he was replaced by Robert B. Boren who was appointed by Governor Jackson on April 18, 1926. Zeigler was reappointed by Governor McCray in 1924, and Geo. E. Hershman replaced Zahrt when his term expired in 1925. Upon the expiration of Campbell's term, Governor McCray appointed A. V. Burch for four years.

The board as at present constituted is Zeigler and Burch, Republicans, appointed by Governor McCray, and Hershman and Boren, Democrats, appointed by Governor Jackson. Lawrence F. Lyons resigned in 1922, and was succeeded by the present incumbent, John D. Williams, who has had long training as a politician, having had employment in the State House upwards of sixteen years. For nearly five years past he has been director of the Indiana State Highway Commission. He has been retained in that position although subjected to severe criticism, and actually under indictment by the Marion County Grand Jury for misappropriation of state property.

The State Highway Commission Law, page 119, Acts of 1919, provides that the Chief of the Division of Construction shall be known and designated as chief engineer (page 122, section 7). On page 124 it provides: "The chief engineer, acting under the direction of the director, shall have supervision of all matters pertaining to highway and bridge construction and improvement as provided in this act."

Until recently, this requirement of the law had not been observed since John D. Williams became director of the Commission. Under his direction in 1922, W. J. Titus was made head of the Bridge Department, and placed on the same salary basis as the chief engineer, Mr. Gray. With the full knowledge and consent of the director, Mr. Titus took entire control of the Bridge Department, hiring and discharging employees at will without consulting the chief engineer.

Plans for Federal Aid bridges were prepared and forwarded to the Federal engineer for approval without submission to Mr. Gray, although his name as chief engineer was required on all plans so submitted. This was evidently put on by Mr. Titus or by some one acting for him since Mr. Gray never gave Mr. Titus authority to sign these plans. Thus an almost independent

and separate organization was built up, in which more office help was used with a far greater overhead than that of the Road Department under Mr. Gray.

A glance over the annual reports of the Commission will give some surprising information. In the report of 1922, page 39, the Bridge Department Report, shows the value of work done on Federal Aid bridges during the fiscal year as $273,006.06 with engineering costs chargeable to these projects, during this period as $20,111.64 or an overhead of 7½%. The commercial charge for bridge engineering by private engineers is 5% of the cost. The Bridge Department cost to the state exceeds this by 50%. The same table shows the *total value* of all work done on these structures (some of which were under construction as far back as 1920), up to September 30, 1922, was $403,974.30 while the total engineering cost was $42,269.38 or an overhead of 10.4%. This does not include any part of the general overhead incurred by reason of the independent office force, but only covers the actual charges to each individual structure.

On pages 40 and 41 of the same report, the total value of all work done on these State Aid structures up to September 30, 1922, is shown to be $286,901.05 with a charge for engineering and inspection of $29,774.92, or an overhead of 10.3%. In addition to the above, there is (on page 44) a charge of $8,176.86, and on page 46 and 47, $4,165.39 and $965.78 respectively, or a total of $13,308.03 for plan and surveying costs of work which had not been placed under contract. In a summary of costs (page 50) is shown a total of all charges for the fiscal year of 1922 as $68,982.31, including a general overhead of $17,660.01, together with a valuation of $566,701.84 for all work done during the fiscal year, thus showing an overhead for the Bridge Department of 12.2%.

A review of the summary of all costs of the Bridge Department for the succeeding year as shown on page 54 of the 1923 annual report is even more convincing of the inefficiency of the Bridge Department as a separate organization, under Mr. Titus. Here is shown a total valuation of work done for the year of $574,660.93, with engineering and inspection of $65,593.13 and a general charge of $18,508.98 or a total of $84,102.11, or 14.6% of the value of work done. When one considers the fact that 5% is the usual charge made by commercial engineers, why should the State of Indiana pay from two to three times that amount?

(To be continued)

A Short History of the Indiana State Highway Commission

(Continued from Chapter II)

CHAPTER III

It was shown in Chapter I that the Indiana State Highway Commission has expended about $72,000,000 and has produced only 1,000 miles of hard surfaced highways, and that at this same rate of progress, thirty years will be required and $300,000,000 more will have to be expended to surface the 7% of the highways of the state that constitute the State system. At the present time Sunday travel out of Indianapolis is already so congested that speeds in excess of 15 or 20 miles per hour are difficult to attain. There is a demand therefore for wider road surfaces, and this demand will increase rapidly in the future as speeds and traffic increase. With waste so great already that our state system is delayed in attainment, we have this added demand for wider roadways. How can they ever be supplied unless the funds provided are expended efficiently?

In Chapter II it was shown that the cost of bridge engineering to the State of Indiana by its Bridge Department for 1923 was 14.6% or nearly three times the commercial rate of 5%. On page 4 of the report for 1923 the Director gives the engineering cost as 3.46% on the total of expenditures; this includes the bridge department cost of 14.6% on its cost, a remarkable comparison in the efficiency of other departments as compared with the Bridge Department. In the annual reports issued by the Indiana State Highway Commission the Road Department shows the per cent of actual overhead chargeable to each project, while the Bridge Department shows no percentages. Mr. Titus, head of the Bridge Department, who under the law should have been subordinate to Chief Engineer Gray, was encouraged by Director Williams in his insubordination, and put out separate survey parties after the Chief Engineer had completed surveys of road projects. Frequently Bridge Engineer Titus would change the locations of structures fixed by Chief Engineer Gray. If that were not possible, the elevations of the finished grade lines were raised or lowered in many instances several feet from the elevation established by the original survey. Apparently, in the opinion of Mr. Titus, none of the survey parties maintained by the Chief Engineer was capable of determining these factors.

Oftentimes, these changes were not made until long after the road plans had been prepared and approved. The Bridge Department has frequently been two years or more behind the Road program. More attention has been paid to small structures on unimportant feeders than to the main highway structures. A notable instance of this is shown in the lack of provision for the dangerous crossing at Dunreith, on the National Road, east of Greenfield, where the entire paving project has been completed since 1922. Also on the National road west of

Terre Haute, where the road was completed in 1922, and dangerous crossings are even yet uncared for. On Federal Aid Project 79 between Lebanon and Lafayette, a number of bridges were delayed, the contracts not being awarded until a year or more after the paving contracts. The same condition exists on many of the most important thoroughfares.

The report of the Bridge Department for 1922 shows a total of 58 structures under contract on State Aid roads, 27 of which were of 20 ft. span or less. A check of the report shows that the inspection and engineering costs on these 27 structures up to September 30, 1922, was more than 10%. Yet only 10 of the structures were completed at that time, the remaining 17 being carried over into the next fiscal year. Summarizing all work done by the Bridge Department from 1922 to 1925 inclusive, as shown by the report of that Department for each year, shows total contract payments of $3,523,114.65 with an inspection and engineering cost of $265,766.88 and an overhead charge of $82,200.92, or a total cost of $347,967.80. This is an over head cost of 8.9% of the work done or almost twice the average commercial charge.

Notwithstanding this evidence of inefficiency, Mr. Titus was made Chief Engineer to succeed Mr. Gray who was dismissed by the Director on a flimsy excuse to be detailed later. With Mr. Gray out of his way, Director Williams immediately placed Mr. Titus as Chief Engineer in charge of all departments as the law contemplated. Apparently the reason for this change was that he now had in Mr. Titus a Chief Engineer on whom he could rely to do his bidding regardless of the technical merit of his requirements. Chief Engineer Titus has been popularly termed a "Yes" man for Director Williams.

Director Williams and Commissioner Crawford have given considerable publicity to the low overhead cost of administering the Highway Commission affairs, giving a figure of approximately 3% of the total expenditures. But this figure, which was improperly given as the total overhead, was actually the overhead of Chief Engineer Gray's Department of Construction, and not of all departments. The overhead of the Bridge Department under Titus has been shown to exceed this amount by from three to five hundred per cent. The Garage Department exceeded it by 1200%. The overhead of all departments combined was shown by the State Board of Accounts to be about 14% under Director Wright, and the only reason it has been lower under Director Williams is because of the efficiency of Gray's department and the increased funds available.

The Bridge Department has been notoriously inefficient. Plans for bridges have been inaccurate, and have been made so complicated and involved with detail that contractors not only have difficulty following them, but the draftsmen have great difficulty making them; all of this has added to overhead of supervision and of design. On one bridge the engineering cost was 40%. That is to say, the actual cost of putting the bridge

on paper and supervising it was almost half as much as the cost of erecting the bridge. When it is borne in mind that the commercial rate for designing and supervising erection of bridges is 5%, this 40% charge should have covered eight such bridges.

In some of the annual reports of the Highway Commission, the Bridge Department has isolated part of the costs so that they do not show in the overhead. Salaries of department heads are also carried in a separate account. Notwithstanding these high costs for bridge engineering on its own bridges, the Bridge Department has held out inducements to counties to do their designing for them at rates far below the commercial rates. Thus, designs for bridges costing nearly $100,000 have been made by the Bridge Department for County Engineers for less than $1,000, or approximately ¾ of one percent. On the Attica bridge in Commissioner Zeigler's county the charge for engineering was approximately 2% of the contract price.

In this way an attempt is made to put commercial engineers out of business so that the state may have a monopoly on the business of designing and supervising all public bridges, whether the funds be supplied by the state or by counties. Obviously, when the inefficiency of the Bridge Department is considered, there can be nothing but waste for the taxpayers in any such arrangement. It means the complete socialization of the industry of bridge engineering in the State of Indiana.

There are numerous complaints of the abuse of the right of petition for approval of plans by the state highway engineer. The Bridge Department has advised some county auditors that if the county would use state plans, there would be no difficulty in getting approval. In this way the Department hopes to create a demand for its own plans among the counties, although the law does not authorize the Department to make plans for counties. Many of the structures built by the State Highway Department have developed defects of design, the blame for which it has attempted to place on the contractor. The State Highway Department now is defendant in numerous suits that have arisen because of faulty plans or ambiguous specifications.

The following letter was published by Engineering News Record of May 3, 1923, criticising an article that Bridge Engineer Titus had contributed in its issue of March 22, 1923:

ENGINEERING NEWS RECORD
May 3, 1923

"Tightening a Bridge Member by Heating and Upsetting.

"Sir:—Your issue of March 22 contains an article, 'Tightening Tension Bars of a Bridge by Heating and Upsetting.' It is no wonder to me any more why the general public refuses to recognize engineering as a profession, and classes the bridge engineer with stationary engine drivers, or plumbers, or carpenters. It seems to me it is high time for the editorial staff of *Engineering News-Record* to apply the microscope of criticism to some of the stuff appearing in its pages.

"If a mechanic or a plumber had tightened the tension member of a bridge in the manner described, it could be said with justification that he didn't know any better, but for a technical organization to

countenance any such quackery goes beyond the range of patience. All the years of patient teaching, scientific research and careful preparation of specifications are thrown into the discard when such things are done—and called 'ingenious.' The general public and many young-old, also-engineers without experience see such things published in a publication of the standing and reputation of *Engineering News-Record* and take it for granted that there can be nothing technically wrong with the method; if there was, it wouldn't be published. Having seen or having read about its being done in one case, on an unimportant structure, he is liable to attempt to do something of the same nature on an important structure, with disastrous results and consequent condemnation of the whole profession by the public.

"If you could tighten the tension members of a bridge by any such method as that described, and get away with it, it would be just as logical, just as sensible—or just as ridiculous and absurd—to attempt to shorten the length of a compression member by heating and putting a kink in it. It wouldn't take a bridge engineer or a testing machine to tell what results to expect.

"I know of one case where a so-called engineer took the plans for a 75 ft. wooden truss highway span and lengthened it out to 84 ft. in the field, and came back to the office glowing with the feeling that he had done something brilliant. When his action was condemned, he couldn't understand what was wrong, and I do not believe he understands yet what was wrong, although the structure had to be taken down and replaced at heavy expense a comparatively short time afterward. In another case, a so-called engineer in an executive position caused the erection of a structure which he called a Howe truss highway bridge of about 60 ft. span without taking measures to transfer the shear of the web diagonals to the chords. When it failed by sagging soon afterward and had to be repaired at heavy expense to the public, he couldn't understand what was wrong with it, and when told what was wrong with it, in somewhat caustic language, he said: 'Well, I only took an hour to design that bridge, and maybe I did overlook something!' He was told that he had better take two hours the next time.

"The question has been asked a good many times in the last few years, what is the matter with the engineering profession? The question is easily answered. It is the engineers themselves. When the time comes that engineers as a whole recognize the undeniable fact that engineering as a profession is an assembly of specialties; that no one engineer is big enough or brainy enough to be anywhere near proficient in them all; that it is just as criminal for an engineer to attempt to design a bridge, or to monkey with a bridge, without having had the necessary training and experience, as it is for a medical practitioner to attempt to perform an intricate surgical operation without having had the necessary arduous years of training and experience as a surgeon, then and not till then will the engineering profession get on solid ground and be recognized as such. And the whole proposition is solely up to the engineers themselves. No layman is going to help them out of the morass of bog."

OLIVER A. HALL,
Designing Engineer, Alaska Road Commission.

Juneau, Alaska, April 12.

"Sir:—Thank you for the copy of Mr. Hall's comment on my account of the method of tightening the truss diagonals on the Millport bridge over the Muscatatuck river, on heating and upsetting, which you published in your issue of March 22. We, of course, recognized the possible danger from the method used and took corresponding precautions. The results justified our efforts, to the best of my knowledge and belief."

WM. J. TITUS,
Bridge Engineer, Indiana Highway Commission.

Indianapolis, April 23.

(To be continued)

(Continued from Chapter III)

CHAPTER IV

A review of overhead costs of the Road and Bridge Departments when operated as separate units by Director Williams in order to make Mr. Titus, head of the Bridge Department, independent of Mr. Gray, Chief Engineer, contrary to the statute which makes the position subordinate, shows some interesting facts that tend to prove the complete lack of ability and inefficiency of the Bridge Department, whose former head has now been made Chief Engineer.

The following is a brief summary of the activities of the two Departments for the months of May, June and July of 1925.

COMPARATIVE OVERHEAD COST ROAD AND BRIDGE DEPARTMENTS

May, June, July, 1925

	ROAD DEPT		BRIDGE DEPT.	
	Salary	Expense	Salary	Expense
May	$13,546.05	$3,857.54	$ 7,168.10	$ 679.22
June	16,922.05	2,225.93	7,174.99	711.76
July	18,540.01	3,153.82	7,382.56	949.19
	$49,008.11	$9,237.29	$21,725.65	$2,340.18
Grand Total		$58,245.40*		$24,065.83

MONTHLY ESTIMATES PAID ON WORK DONE

	Road Department	Bridge Department
May	$ 179,851.41	$ 49,836.69
June	622,763.13	115,568.20
July	732,031.00	108,550.06
	$1,534,645.54	$273,954.95

* Includes $9,468.49 chargeable to Surveys and Right of Way.

OVERHEAD COMPARISON

Roads—3.8%. Including all survey and right of way costs.
Bridges—8.7%.

When Mr. Gray left the Commission in the summer of 1925, the following was the personnel in direct charge of field and office work:

	Per Month	
Road Engineer	$250.00	
First Assistant Engineer	200.00	
Second Assistant Engineer	200.00	
		$650.00
Office Engineer	$250.00	
Assistant Engineer	200.00	
Assistant Engineer (on reports)	125.00	
Stenographers (3)	280.00	
Clerk (1)	120.00	
		$975.00
Total		$1,625.00

A year later, in June, 1926, this salary list had been increased under Mr. Titus as Chief Engineer to the following amounts:

	Per Month	
Road Engineer	$300.00	
Construction Engineer	250.00	
First Assistant Engineer	235.00	
Second Assistant Engineer	225.00	
		$1,010.00
Office Engineer	$250.00	
Assistant Office Engineer	150.00	
Assistant Engineer (on reports)	145.00	
Report Clerk	125.00	
Mail Clerk	115.00	
1 Clerk (salary and expenses)	120.00	
2 Stenographers at $110	220.00	
2 Stenographers at 100	200.00	
		$1,325.00
Total		$2,335.00

This is an increase of approximately 50% in one year.

There is here seen an unwarranted increase of $710.00 per month or $8,520.00 per year for practically the same volume of work done as under the direction of Mr. Gray. A check of salary and expense vouchers in the State Auditor's office for the month of May, 1926, will show a total of $17,016.06 chargeable to the Road Department, while the value of contract payments for the same period was $108,053.31 or an overhead charge of nearly 16%.

In contrast with the above increased overhead is the decrease in total expenditures of the Department. Investigation at the Auditor of State's office shows that from the beginning of the fiscal year October 1st, 1925, to July 1st, 1926, the total expenditures of the Commission were only $7,311,718.82 as against

$9,577,315.79 for the same period in 1924-25, or a decrease of more than 25%.

Despite the predictions of the Commission for the largest paving program in history for 1926, a review of contracts under way July 1st shows that only 158 miles of pavement have been awarded since September 30, 1925, and that many projects for which bids were received throughout the spring and early summer have not been awarded. Yet in the face of the enormous decrease in the volume of work done and under way, we have an increase in the overhead expense of the Road Department alone of 43.6% since Mr. Titus was substituted for Mr. Gray, as Chief Engineer.

The removal of Mr. Gray as Chief Engineer grew out of his refusal to submit to Director Williams' dictation in an engineering controversy. Marion County had submitted to the highway commission for its approval, plans and specifications for the construction of the Frank Mann Road. These specifications, prepared by the County Surveyor provided for the use of crushed stone of gravel as a coarse aggregate for concrete, and while somewhat more rigid as to the sizing of material, than the standard specifications in use by the highway commission, they, nevertheless, permitted a choice between the two materials specified and would produce a better concrete than the state specifications. This was the attitude of Mr. Gray in making his recommendations, that is, that the State Highway Commission had no authority to say to the officials of any county "that they cannot build a better road, or use a better specification than the highway commission."

The following is a copy of Mr. Gray's letter relative to the controversy:

"Mr. John D. Williams, Director,
Indiana State Highway Commission,
Indianapolis, Indiana.

Dear Sir:

"Referring to official information given me by you July 26, that you had been instructed officially by the Commission at its last meeting, to have the chief engineer have all county specifications for state approval, comply with our standard specifications for coarse aggregate before approving same, I wish to call your attention to the fact that this order and the establishment of this policy by the Commission is in direct disagreement with the report which I have previously made to the Board of County Commissioners of Marion County on the Frank H. Mann road, designated by us as County Aid Project No. 194. You will recall this report was submitted to you and approved by you.

"The approval of plans and specifications is purely an engineering matter responsibility for which as I interpret both the County unit road law and the state highway act, rests with the chief engineer. I have gone into the matter of the specifications for coarse aggregate on the road referred to, very thoroughly, and I have gone over the specifications in detail with our testing engineer who has specialized in this line of work, and we are both of the opinion that, since the specifications are more rigid, and undoubtedly, everything else being equal, will add in some degree to the strength of the result-

ing concrete, it is not fair to the Board of County Commissioners of Marion County and their engineer to take the position that we will not permit them to deviate in any way from our specifications. The deviation in this case will without question result in a pavement of equal, and in all probability, of greater strength than ours.

"I wish again to call your attention to the fact that the Marion County specification is not a closed specification. There are plants within reasonable and practicable shipping distance of Marion County which can furnish gravel meeting their specifications in fair competition with stone. I am not even convinced that these specifications exclude all Marion County plants.

"If you are familiar with Marion County pavement, you know that the pavements built during the last two or three years are far superior to those previously constructed, and I am of the opinion that the improvement of their specifications for coarse aggregate has contributed to this condition, as well as improvement of other features of the specification and better design.

"The county unit road law provides that the materials used in any county road must be equal to the standards adopted by the highway commission. I am of the opinion that we have no legal right, and most certainly it would not be fair, to tell any board of county commissioners that we would not permit their engineer to improve in any way upon our specifications relative to coarse aggregate.

"I assume full responsibility for our specifications and believe that the resulting pavements are adequate to carry the present day traffic. As to the future intensity and kind of traffic, the best any of us can do is to guess. Since the life of our roads is dependent on this more than any other factor, we have no assurance and can only hope, that they prove adequate in the future as well as the present. It appears to me that the county engineers with whom we deal, have as much right to their opinions as we have, especially when the science of road building has not advanced to the point where we can definitely establish that they are wrong. I have made an earnest effort in the last six years to raise their standards to our standards, but I would not be a party to making my own ideas a dead line beyond which they cannot advance, within reasonable economical limits.

"It is not fair to ask me to assume this responsibility and to attempt to force me to take action that is against my engineering experience, my better judgment, and my ideas of fairness. I am willing to act on these plans and specifications as well as any others, and to assume full responsibility for my action, providing I am permitted to use my better judgment, and base whatever action I may take on my engineering training, experience, and sense of fairness.

"It appears to me that the Commission interprets the law in a manner that would place the responsibility for approving plans and specifications, or disapproving the same, with them; while I do not so interpret the law, I wish to make it plain that if they wish to assume this responsibility and transmit their final decision under their own or their director's signature, directly to the county officials, then I will be willing to make such recommendations as I see fit to them for their consideration of each set of plans and specifications, if they so desire.

"If, however, their order means that I am to handle the approval or disapproval directly, and base it on their policy, regardless of my views on the matter, I cannot and will not comply with their orders."

GRAY, Chief Engineer.

(To be continued.)

A Short History of the Indiana State Highway Commission

(Continued from Chapter IV)

CHAPTER V

The letter from Mr. Gray resulted in his dismissal by Director Williams to take effect August 15, 1925. The Director appointed in his stead, W. J. Titus, who as Bridge Engineer had not been able to keep up with the road building program, and who had never built a mile of road, although the law requires that "the Chief Engineer be a competent civil engineer thoroughly experienced in Road and Bridge construction." The Director now placed the entire construction division, that is the road, bridge, and testing departments under the direction of Chief Engineer Titus, as the law requires, a condition that Mr. Gray had for years contended for, yet could not bring about, by reason of the opposition of the Director in favor of Mr. Titus.

Following the resignation of Chief Engineer Gray and the appointment of Mr. Titus to the position, members of the engineering staff resigned, giving as a reason that they would not work for one so obviously lacking in executive ability. This, of course, was one of the outgrowths of the differences that had grown up between the two department heads because of encouragement by Director Williams to the insubordination of the head of the Bridge Department.

The controversy about gravel grows out of the influence of the Indiana Sand and Gravel Producer's Association over the policy of the Indiana State Highway Commission. This is due to the activities of S. C. Hadden, who was made secretary of the Association about two years ago. Mr. Hadden is Editor of "Municipal and County Engineering," a monthly journal published by the Engineering Publishing Company and also of "Indiana Highways" published by the same company. He organized the "Allied Motor Commerce" which was later changed to "Indiana Highway and Motor Association," and was its secretary.

These organizations were his means for securing publicity for activities in favor of more expenditures for highways. For some time Mr. Hadden has been active on the floor of the Legislature as a lobbyist and was registered as such in the 1925 session of the General Assembly. The Indiana Sand and Gravel Producer's Association saw in his activities and connections an opportunity to commercialize them and for a salary of $3600 a year his energies and his periodicals were devoted to defending the Commission.

As an illustration of his methods his journal "Indiana Highways" has at times been filled with praise of the Commission and vituperation of his competitors and of County Officials. The following is quoted from "Indiana Highways" of August, 1925:

"Crushed stone interests have long been perniciously influential in Indiana County Official's organizations as everyone in the construction business in Indiana well knows."

The actual controversy over gravel in Marion County arises from the amount of sand and grading of sizes. Marion County gravel pits all contain an excess of sand, which cannot be sold

to advantage. The State Highway Commission specifications permit a more liberal inclusion of the objectionable material. This might be offset by using more cement in which case a concrete of equal value could be produced although at higher cost. The Highway Commission, however, does not specify additional cement but maintains that the material is equally good notwithstanding the unfavorable grading. In this it is supported by tests made by Fred Kellam who was in charge of the Testing Department and who has now succeeded Mr. Titus in charge of the Bridge Department.

Of course very one must concede that if one unit of concrete contains more sand in proportion to cement than another it must be weaker but the testing department maintains that its specification is sufficient. Mr. Hadden maintains for the gravel association that Marion County tries to exclude its own home product, to the advantage of its competitor, crushed stone. It would seem that gravel dug out of the ground in Marion County should be able to meet the competition of stone crushed by power and shipped from Greencastle, Indiana to Marion County but the gravel producers refused to do so. This cannot be, because of the specifications, for the addition of small amount of cement, or the omission of a part of the sand, and the addition of a small amount of coarse material would make Marion County gravel meet the requirements.

Instead of meeting this competition fairly, the Gravel Association files petitions against such improvements to carry the bond issues to the State Tax Board for review and the Tax Board holds against the bond issues thus preventing the improvement. The Tax Board in deciding such cases, is influenced by the attitude of the State Highway Commission. John J. Brown, Chairman of the Tax Board occupied the same room at the Roosevelt Hotel with Earl Crawford, the indicted member of the highway commission. He also holds frequent conferences with Director Williams.

Contractors competing for public work make use of attorneys to work up petitions in opposition to other contractors who are not looked upon favorably by the highway commission or the tax board. John J. Brown, Chairman of the State Tax Board, keeps his automobile in the garage of the State Highway Commission and buys gasoline from the State, thus avoiding the payment of the 3c a gallon gasoline tax. Earl R. Crawford, while a member of the State Highway Commission, gave orders that employees of the highway commission should render favors to Hadden, Secretary of the Indiana Sand and Gravel Producer's Association, and to put all obstacles possible in the way of the stone producers because as he said, "The gravel interests helped us to kill the Ripper Bill in the Legislature."

Yet while thus acknowledging control by material men, both Crawford and Hadden charge that others are trying to take political control of the commission. What they mean probably, is that if the Governor were to have the appointment of the Director, he would dictate the appointment of all subordinates. Under the present organization these subordinates are chosen,

not for efficiency but for the advantage of Director Williams, and the Commission. It has been charged that the Democratic members of the Commissions have been given so many appointees to keep them favorably disposed towards Williams that the highway commission has become a Democratic machine under a Republican Governor.

Obviously there is here neither party nor Executive responsibility for the doings of the commission. It consists merely of a bi-partisan body profiting individually by appointments and by location of improved roads in the districts of the most influential to maintain organized inefficiency. The most of its activities are devoted to defending itself. Where formerly it published in the newspapers articles laudatory of its own accomplishments, it now employs a publicity agent jointly with the Conservation Department, C. W. Parish, part of whose time is given to preparing articles in defense of the commission which are published by favorable newspapers, almost verbatim as prepared.

Another influence over the highway commission is the Portland Cement Association. This is an association of Portland Cement Manufacturers throughout the United States, each of whom contribute one cent on each barrel of cement manufactured, to the funds of the association for promotion and advertising of Portland cement. The headquarters are in Chicago and it maintains a local office in the Merchants Bank Bldg., at Indianapolis. The contributions from the manufacturers amount to upwards of $800,000.00 a year.

Despite the fact that the State Highway law requires the commission to receive bids on at least three comparable types of paving, the past four years have seen practically no competition along this line, by reason of the evident influence of the cement industry, through the Portland Cement Association. This organization employs a staff of highly efficient and trained men, presumably to promote the proper use of cement; but primarily its object is to create a demand for, and sale of the enormous output of the cement manufacturers. To this end, close touch is kept with all State Highway Commissions and large construction projects, and every effort made during the legislative sessions of the various states to assist in securing legislation that will be of material benefit to the cement industry.

Offices are maintained, in thirty (30) of the larger cities of the United States, including Indianapolis, from which the work of this organization is directed, and whenever a street or road improvement is proposed in any locality, immediate activity on the part of the association is noted and every effort made to influence the taxpayers to petition for concrete in prference to all other types of pavement. While the existence of any trust of combine is most emphatically denied, nevertheless a study of bids submitted to the State Highway Commission for the past four years, by the various cement companies located in the middle west will reveal some interesting disclosures relative to lack of competition. In a large majority of instances, when the freight rates are considered, the base price, or mill net, is the same in each case, regardless of the location of the cement

plants, and this fact was the cause of the commission's rejection of bids in 1922, when the state first started buying cement, and their statement at that time, that a cement trust evidently existed.

By reason of the fact that the Commission has, since 1922, furnished all cement used in its paving program, a competition with all other comparable types of paving has been eliminated, and while estimates are now made, and bids advertised for on brick and bituminous concrete, (as a matter of form), it is a rare occurrence when a bid on any type other than cement concrete is received. This will be understood when one considers the advantage offered the contractor when the state furnishes the cement. Were the contractor required to supply this material, he would have to carry an additional expense of from $7,000 to $8,000 per mile, plus the freight charges and this would have to be met promptly in order to avoid the loss of the usual discount allowed for cash in ten days.

By the purchase of cement, the commission loans to the cement contractor, without interest, from $7,000 to $8,000 per mile, to carry on his operations although estimates are paid on all work once each month for 90% of the completed amount. The present commission, therefore, in plain violation of the statutes, eliminates the competition these statutes expressly require, with the result that no pavement other than cement concrete is likely to be constructed while this condition exists in Indiana.

The hue and cry of the Indianapolis News has been for more than a year, "that the politicians were trying to get control of the highway commission," when the truth of the matter is, that politicians are now in control. The Indiana Sand and Gravel Producer's Association and the Portland Cement Association by their activities in the Legislature and through their publications, control the policy of the commission in purchase of materials.

When the so-called "Ripper Bill" was before the last legislature in an effort to eliminate these same politicians, a hurried scramble was made by those behind the scenes to overcome this movement; by promising that a complete investigation of affairs would be made, the bill was defeated. Had the conditions now disclosed been discernable then, even the Democratic members who helped defeat the measure should have taken a different attitude and Indiana today would have been freed of this control.

Under the law the highway commission is a **bi-partisan** board composed of two Republicans and two Democrats. It is thus neither Republican nor Democratic and no one but itself is responsible for its actions. Its Director, who has charge of the expenditure of $15,000,000 a year or $40,000 for each day of the year, by granting favors to the members of the commission, is able to make of himself a power higher than the Governor of the State himself. Under these conditions Director Williams is answerable to no man. He seems to respond to the **bi-partisan** control of the Portland Cement Association and the Indiana Sand and Gravel Producers' Association. His resignation has been demanded but the demand has been treated only with contempt.

(To be continued.)

A Short History of the Indiana State Highway Commission

(Continued from Chapter V)

CHAPTER VI

Marion County has maintained that the state specifications for gravel do not make satisfactory roads. Samuel C. Hadden, Editor of "Indiana Highways" and Secretary of the Indiana Sand and Gravel Producers' Association, on the other hand, has given much space and editorial labor, to prove that gravel is the equal of stone, thus defending the State Highway Commission and its Director in their use of gravel and their elimination of Mr. Gray as chief engineer, and at the same time promoting the business of the Gravel Association.

Mr. Kellam, formerly testing engineer for the Commission, and now head of the Bridge Department made a report published in the October, 1925, number of Mr. Hadden's magazine giving the results of tests made on concrete cores, taken from pavements in which gravel was used as coarse aggregate and others in which limestone was used. His final analysis shows that of all cores so tested, those with gravel as aggregate averaged 4650 lbs. per square inch, while those of stone averaged 4800 lbs.

The article also states that the State specification was worked out under the supervision of Prof. W. K. Hatt of Purdue, an expert of international reputation, jointly with Mr. Kellam. Prof. Hatt is State Engineer of Indiana appointed under the conservation law of the State. What the article does not state is that Prof. Hatt at that time was making the tests for, and was paid by, the Gravel Association of which Mr. Hadden is now Secretary.

Mr. Kellam's experience as a testing engineer has been limited almost entirely to his connection with the State Highway Commission. Additional information on the comparison between gravel and stone is to be had in a report on investigations made by the Bureau of Tests of the United States Bureau of Public Roads entitled "CRUSHED STONE OR GRAVEL" published in June, 1925, which outlines in detail the results of tests over 24 miles of the "OHIO POST ROAD" between Columbus and Zanesville, Ohio. The best evidence of deterioration of a concrete pavement is the number of cracks shown, rather than the compressive strength. The surface breaks down and disintegrates at the edges of the cracks.

CRUSHED STONE or GRAVEL

A Survey made for the Division of Tests
United States Bureau of Public Roads
By F. H. Jackson, Engineer of Tests

"One of the first concrete pavements of any considerable length to be constructed in the United States was laid in 1914 and 1915 on a section of the old National Road between Zanesville, Ohio, and the Moscow bridge over the South Fork of the Licking River, a distance of about twenty-four miles. The pavement, built under the joint supervision of the State of Ohio and the United States Bureau of Public Roads, and known as the Ohio Post Road, has now been under traffic for more than ten years and is still in good condition.

"Fortunately there is available a detailed record of the materials and methods used in the construction, and there is the possibility, so often lacking, of studying the present condition in the light of the conditions obtaining during construction. With this possibility in view the road was inspected for the Bureau of Public Roads in November, 1924, and observations made at that time are recorded in this article.

"*One condition that stands out very clearly is the greater amount of cracking that has occurred in parts of the pavement in which uncrushed gravel was used as the coarse aggregate* in comparison with other parts in which the aggregate was crushed limestone. There were about twice as many full transverse cracks per mile in the gravel as in the limestone concrete sections.

"Another noticeable condition is the entire absence of scaling, which the writer attributes to the fact as evidenced by the records, that the sand was exceptionally clean, the mix dry and the finishing moderate. So excellent is the surface in this respect, and so strong the indications of the records that the result is due to the construction conditions mentioned, that the writer feels justified in saying that more careful attention to these details should go far toward eliminating scaling on new construction.

"The observations also add to the evidence which is piling up from similar investigations in many parts of the country that there is an intimate relation between the extent of cracking pavements and the character of the soil immediately below the pavement.

GENERAL DESCRIPTION OF THE ROADS.

"Ten of the twenty-four miles were surfaced with 1:1½:3 concrete using the uncrushed gravel aggregate, the remaining fourteen miles with 1:1¾:3 concrete in which the aggregate was crushed limestone. Throughout its entire length the pavement is sixteen feet wide, and the slab, which is eight inches thick at the center and six inches at the edges, rests on a flat subgrade. Contraction joints were spaced thirty feet apart and were skewed at an angle of 15 degrees with the center line of the road.

MATERIALS AND CONSTRUCTION METHODS.

"Records of the physical tests made on the Portland cement used indicate that it passed all of the usual requirements. The sand, obtained from a washing plant at Dresden, Ohio, was exceptionally well graded and clean. As previously stated, both uncrushed gravel and crushed limestone were used as coarse aggregates. *The gravel was* obtained from the same source as the sand, and was *of good quality. The limestone, also of excellent quality,* was obtained from one of the Scioto River quarries near Columbus, with the exception of that used in about 4,500 feet of the pavement, which was obtained from a local quarry. The characteristics of both materials are indicated in Table 2. The water, pumped from streams crossed by the road, was also of good quality.

TABLE—2 RESULTS OF TESTS OF COARSE AGGREGATE.

Sample No.	Materials	Mechanical analysis—total retained on screens. 1½ Inch	1 Inch	¾ Inch	½ Inch	¼ Inch	Wear	Toughness	Hardness
		Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.
1	Limestone	9	44	73	96	100	---	---	---
2	"	3	59	80	97	100	---	---	---
3	"	---	13	51	90	100	---	---	---
4	"	---	---	---	---	---	3.4	8	16.7
5	"	---	---	---	---	---	3.2	5	15.8
6	"	---	---	---	---	---	3.3	12	18.5
7	"	---	---	---	---	---	3.9	15	17.6
8	Gravel	---	5	31	72	92	---	---	---
9	"	---	24	45	73	96	---	---	---
10	"	---	4	15	37	82	---	---	---
11	"	1	6	17	49	96	---	---	---
12	"	---	6	17	50	86	---	---	---

"The concrete was mixed in one-half cubic yard paving mixers of the boom-and-bucket type, and in general the mixers were so operated that each batch of concrete remained in the drum at least forty-five seconds. Great care was exercised to regulate the consistency of the mix so that the concrete would hold its shape after being placed, struck off, and finished. All reports on file indicate that more than usual attention was given to this feature, and that the concrete was, if anything, too dry rather than too wet. This point is also of interest in view of the present condition of the pavement. The concrete was struck off by means of a wooden strike board and tamped with a steel templet six inches wide and shaped to conform to the surface.

"The work of finishing the surface proceeded immediately after the tamping, and was accomplished by means of wooden floats of two sizes; one about eight feet long, operated by two men, and the other about two feet long, operated by one man. The long float was operated from two bridges and was shoved back and forth longitudinally across the pavement. The short one was for final finishing. For the most part the surface was brought to final finish not more than fifty feet behind the mixer. Although the finish was good, there was no attempt to secure a surface of exceptional smoothness, such as is frequently made in current practice. There was consequently little tendency toward overfinishing. Thus, it is noted that three of the factors which from time to time have been brought forward as causing surface scaling, viz.: excessive fine material in the sand, wet mix, and overfinishing, were conspicuously absent on this job.

RELATIVE CRACKING OF GRAVEL AND LIMESTONE CONCRETE.

"As the same sand and cement and the same details of construction were used throughout, the possibility of comparing the behavior of the two kinds of concrete was anticipated when the road was built, and two special experimental sections were laid. *The sections were so located as to have practically identical traffic, subsoil, and drainage conditions.* Both were constructed through gently rolling country; each contained approximately the same amount of pavement through cut and on fill; and each was constructed with contraction joints varying from 30 to 100 feet apart, the distances changing by increments of five feet and repeating for a distance of approximately one mile in each case. All the conditions on these two experimental sections being so nearly alike, with the exception of the kind of coarse aggregate, it is interesting to compare the relative amount of transverse cracking which has taken place in them during the ten years since they were constructed and with this in mind a detailed crack survey was made at the time of the recent inspection.

"The results of the crack survey are reproduced in Figures 1 and 2. It will be seen at once that *many more cracks appear in the uncrushed gravel section than on the crushed limestone section.*

"The relative amount of cracking may be determined in a number of ways. For instance, by counting the actual number of concrete slabs formed by the cracks and joints on each section and dividing into the total area of the section, we obtain the average area of concrete slab in each section after the ten years of service. Calculated in this way, we find that *the average area of the concrete slabs as they exist today on the gravel section is 137 square feet, whereas the average area of the slabs on the limestone section is 320 square feet—about two and one-half times greater.* Comparison of the two sections likewise shows that, whereas, *on the gravel section every one of the original slabs has cracked at least once, on the limestone section there are eleven slabs still intact.* One of these is twenty feet long; four are thirty feet long; two, thirty-five feet long; two, forty feet long; one, forty-five feet long; and one, fifty feet long. *There are 230 full transverse cracks on the gravel section and 107 on the limestone section.* The full transverse or contraction cracks on the gravel concrete section average twenty-four feet apart as against fifty-four feet on the limestone concrete section.

"*Inasmuch as soil, drainage, and traffic conditions are practically identical, it would appear that the difference in cracking was due to some characteristic of the concrete itself. As previously stated, a slightly richer mix was used in the gravel concrete— i. e.,* 1:1½:3 *as against* 1:1¾:3 *for the limestone concrete—but all other factors remained exactly the same, with*

the exception of the coarse aggregate. It is fair to assume, therefore, that the difference in the cracking of these two sections is due to the character of the coarse aggregate used. Results of typical compression tests of the concrete made on specimens cast at the time of construction show that there is very little difference in the crushing strength of the two classes of concrete. Unfortunately, there are no transverse tests of the concrete available, *but it is possible that the difference in cracking is due to the high tensile strength of the limestone concrete."*

From the above report it will be noted that the result of compression tests, such as were made by Mr. Kellam showed very little difference in the crushing strength of the two classes of concrete, which agrees with Mr. Kellam's statement, but that was all he had to base his statements on since he had no field experience or field tests, such as is shown in the above report, which clearly shows what might be expected, not the day after the work is completed, but years hence and that is what we must look forward to and build for, service in the years to come. It will be noted that the soil, drainage and traffic conditions were identical on both sections of the road, and the same sand and cement were used, the only difference being the coarse aggregate.

One of the outstanding features of the report, is that there were about twice as many full transverse cracks in the gravel section, per mile as there are in the section where stone was used. Another important thing is noted in the report of screen tests on the material used. While no material less than ¼ inch was in stone aggregate the samples of gravel recorded show an average of only 9.6% passing through a ¼" screen, while the Indiana Highway Specifications allow 15%. Yet, despite the care taken to eliminate the fine material, the resultant concrete was far below the standard of that in which stone was used for coarse aggregate. The final analysis shows that the gravel concrete cracked 2½ times greater than the stone which tends to show that while the crushing strength of the two materials were practically the same, the tensile strength of stone is far greater.

(To be continued.)

A Short History of the Indiana State Highway Commission

(Continued from Chapter VI)

CHAPTER VII

In the preceding chapters, it has been shown that the Indiana State Highway Commission has expended approximately $72,000,000. That it is now spending at the rate of $15,000,000 a year, which is upwards of $40,000 for each and every day, including Sundays. That the State System consists of about 7% of the 75,000 miles of highways in the state, or approximately 5,000 miles. That of this 5,000 miles, 1,000 miles has been paved up to the present time. And that $300,000,000 and thirty years will be required to complete the system. That before that time, the first roads will be worn out and the demand for wider pavement will compel even more expenditures.

There seems no promise of solution of our highway problem under the present system, because of the inefficiency and lack of executive ability of the bi-partisan commission, its director, and chief engineer. It has also been shown that it is under the control of the Portland Cement Association, and of Samuel C. Hadden who is Secretary of the Indiana Sand and Gravel Producers' Association. The Portland Cement Association is now publishing forty-inch advertisements in the influential newspapers of Indiana. One of the Indianapolis newspapers which was rather critical of the Highway Commission is publishing such an advertisement each week. Of course, newspaper policy cannot be controlled by such methods, but evidently the Portland Cement Association does not know it.

Samuel C. Hadden, Secretary of the Indiana Sand and Gravel Producers' Association, is a Democrat, and was at one time seeking appointment as one of the Democratic members of the Highway Commission. During the last session of the Indiana Legislature, he was a registered lobbyist, and was an energetic defender of the Highway Commission, in return for which his gravel interests received patronage. He was a bitter opponent of the Kissinger road bill which provided that the former Highway Commissioners and Director should be removed, and a new Board and Director be appointed by the Governor. This bill passed the House, but died in the Senate. It was labelled the "road ripper" bill by its opponents.

To defeat this bill, Hadden circulated numerous stories about the connection of Stephenson and the Klan with the bill. The stories thus circulated on the floor of the Legislature were spread by word of mouth throughout the state during the succeeding eighteen months before the 1926 election. One such story was that Governor Jackson had borrowed $90,000, or $165,000, or $275,000, from D. C. Stephenson, promising to pay back by advantageous contracts in the highway department. This story was heard on all sides with varying amounts. Even pastors of churches, of Democratic sympathies, were busy passing them along.

When Stephenson was indicted for murder shortly after the close of the Legislature, he was imprisoned for some time at Noblesville before trial and busied himself with a typewriter in prison, the supposition being that he was writing a book. He must have been familiar with the stories that had been circulated, and must also have known that there was a chance that he would be convicted of murder. What more likely then, than that he may have fabricated documents to support some of the stories that had been circulated, in the belief and hope that by means of such documents he might be able to hold a club over those who could help him to freedom. He was alleged to have made the statement that if he was convicted, he would see that others were sent to prison.

Into this situation came Thomas H. Adams, of Vincennes, believing what was told him by Court Asher, who seems to have been given custody of some of Stephenson's papers. Adams, a Republican, was Editor of the "Vincennes Commercial." It was he who tried to pass a resolution in the Republican Editorial Association, eulogizing the Highway Commission. He thus became associated with Hadden, who was also an editor, of "Indiana Highways," and who was intensely interested in the retention of the present Highway Commission. Statements given by Adams to the press, in October, 1926, as a part of his charges of corruption of public officials, were prepared by Hadden. These statements were given great prominence by the Indianapolis Times, a Democratic newspaper. During this October campaign, almost daily and nightly meetings were held by Adams with officials of the Highway Commission. The Highway Commission was in need of defenders because some of its officials were under indictment for embezzlement of state property.

The War Department of the United States Government had millions of dollars of war material left after the World War, some of which was suitable for highway equipment. Congress passed a law, transferring such equipment to the Department of Agriculture, and giving the Federal Road Bureau authority to distribute it to the states. Such as was suitable for road work would become the property of the state. That not suitable could be requisitioned by the state and sold, but the title of the property and of any money received for it, must remain in the Federal Government and such funds must be used only on Federal Aid Roads.

Officials of the Indiana State Highway Commission consulted with junk dealers and requisitioned from Washington material originally worth about $9,000,000. This material was shipped to Indiana and disposed of without public competition, often by private sale to the junk dealers who had helped prepare the requisitions. The material was handled by Highway Commission employees, and freight to the amount of over $400,000 additional was paid by the state; yet the total amount realized from the sales was only approximately $500,000. For some of the materials there was no accounting whatever and the Marion

County Grand Jury voted indictments against one of the commissioners, the director, and three others.

There may be some doubt as to the question of title, that is, whether vested in the State of Indiana, or in the Federal Government, and the amounts actually proved embezzled may be small, but there is no question that property belonging to the Federal Government was sold contrary to law at a tremendous loss. The Marion County indictments have not yet come to trial because a Federal investigation is now under way to determine whether or not the Federal laws had been violated in disposing of these goods.

Charges of loose methods of operation in the purchase of equipment by the Director of the Highway Commission were also made by the State Board of Accounts; O. F. Schlensker had been accused of selling to the Highway Commission at excessive prices. It was shown that, in the case of one item, the selling price to the Highway Commission was **fifty-four times** its normal price. In settlement of the excessive charges, Schlensker paid into the State treasury $50,000. Afterwards, he was influenced to sue for its recovery. The five Marion County judges sitting en banc, held that he could not recover.

The charges made by Thomas H. Adams, first published in the Indianapolis Times of October 4, 1926, included one story that a prominent state official had borrowed $275,000 from Stephenson and had agreed to repay to him three times that amount. This has all the ear-marks of the same story circulated by Hadden, that Stephenson had loaned hundreds of thousands of dollars to the Governor of Indiana. Of course, the story is not to be believed, because no Governor of Indiana could repay $825,000 either from his own pocket or from any other source accessible to him. Nevertheless, on the basis of such charges, the Grand Jury was summoned, in October, 1926, and has devoted weeks to investigation, and has examined nearly one hundred witnesses.

One of the deputy prosecutors of the Grand Jury is the attorney for the Indianapolis Times, which has given publicity to the Adams charges, and whose editorial policy is a demand that these charges be substantiated by the Grand Jury investigation. He was recommended to the Prosecuting Attorney by the Indianapolis Times. Frank J. Prince has been publicity agent for Thomas H. Adams, and occupies a desk in the editorial room of the Indianapolis Times. He has served two terms in prison for issuing fraudulent checks. His publicity work for Adams was supervised by the attorney for the Indianapolis Times, who is deputy prosecutor for the Grand Jury.

Under these conditions, most favorable to Adams and to the Indianapolis Times, little progress nevertheless, seems to have been made towards substantiating the charges. The stories are a fabrication of inconsistency, forced upon the public by Adams and Hadden, with the assistance of ex-convicts who have nothing to lose by perjuring themselves, and by indicted officials who have everything to gain by charging honest men with fraud. Before election the Grand Jury reported that it had no indictments against candidates.

In the Indianapolis Star of Friday, October 8, McDermond, President of the Republican Editorial Association, explained the Adams Exposé by saying that Mr. Adams was appointed chairman of the transportation committee to investigate mail deliveries. He said that Adams corresponded with the railroads, and finding little promise of improvement, turned to the motor bus, thus coming in touch with the State Highway Commission; he found that it was being persecuted and that framed indictments had been returned to punish the Commission for refusing to be a party to the plot to raid the state.

In the Chicago Tribune of October 9th, Adams explains his position by saying that the Kissinger "road ripper" bill to abolish the Highway Commission was presented in the Legislature and a construction company formed in which Stephenson and state officials were members. Adams says he and others in the senate killed this bill and Stephenson was then reported "wild with rage." Then, says Adams, the indictment was used to get rid of honest officials.

Adams gave an interview to the Chicago Tribune of October 4, 1926, quoting from a letter written by Stephenson to Asher. In it Stephenson said, "I will give you a complete statement of the framed indictment against the highway commission." In another letter from Stephenson, published in the Indianapolis Times of October 6, 1926, Stephenson said, "In order to avoid paying those various sums, and because I would not help frame the highway commissioners, the men who are so indebted to me, (the same men who framed the highway commission,) seized upon the convenient suicide of an unfortunate Indianapolis woman to force an indictment against me for murder."

Why should Stephenson have refused to help frame the Highway Commissioners, if he was "wild with rage," because the Kissinger bill was not passed? Was his character such that he could not stoop to such an act? The Kissinger bill was not to abolish the Highway Commission, but to remove the old highway commissioners and substitute new ones. According to Adams' story, Stephenson was to profit by this scheme. Now in the letters which Adams has produced from Stephenson, Stephenson becomes the defender of the Highway Commission. Does he hope by such methods to gain his freedom? Or have Adams and the Indianapolis Times been deceived by Hadden's propaganda?

Here follows the cast of characters in the Adams Exposé:—

Thomas H. Adams, Editor, "Vincennes Commercial."
Frank J. Prince, ex-convict, Publicity Agent for Adams.
David C. Stephenson, convicted murderer.
Court Asher, indicted, Delaware County.
Earl Gentry, indicted, Marion County.
Earl Klinck, indicted, Marion County.
John D. Williams, indicted, Marion County.
Samuel C. Hadden, Secretary, Indiana Sand and Gravel Producers' Association.

(To be continued)

A Short History of the Indiana State Highway Commission

(Continued from Chapter VII)

CHAPTER VIII

In Chapter VII, quotation was made from one of the Stephenson letters, which was published in the Indianapolis Times of October 6, 1926. The quotation, of which this sentence is the concluding paragraph, is as follows:

> "Parts of the alleged letter from Stephenson given out by Adams are of such nature that they cannot be printed. Vital portions, however, may be quoted. They are:
>
> I have in a place of security the following described documents:
>
> 1. A written contract by the terms of which a certain prominent official of the State of Indiana agrees to pay the sum of $825,000, or three times the amount I expended in his behalf for election.
>
> 2. I have notes representing the above amounts, signed by the officials.
>
> 3. I have a written memorandum signed by the same official acknowledging the amounts expended by me in his behalf to be $275,000, or one-third of the sum above mentioned. This memo recites an agreement where I lose all if he was beaten in the election, but receive three-for-one if he won.
>
> 4. A written agreement with the mayors of three large cities in Indiana, binding them to pay me on a ratio of three-for-one for all money I advanced in their behalf, and further agreements are in my possession where these same men agreed to allow certain individuals to name all appointments.
>
> 5. I hold two photographic copies (and the plate) of an agreement by and between the mayor of a large city and an organization politician in which the mayor agrees to allow that politician to name all of the city appointees of a certain class. I also have eight affidavits of reputable men who saw photograph made from the original. I later delivered the original to the politician to whom it was addressed by the mayor.
>
> 6. I have perhaps thirty or forty contracts with less important public officials who have agreed to repay me for funds advanced to them for campaign purposes.
>
> In order to avoid paying those various sums **and because I would not help frame the highway commissioners**, the men who are so indebted to me (the same men who framed the highway commission), seized upon the convenient suicide of an unfortunate Indianapolis woman to force an indictment against me for murder."

This last involved sentence contains more than appears on its surface. Stephenson, if he wrote this sentence, here charges that he loaned money to state officials, presumably the Governor of Indiana in particular, and was then called upon to help secure indictments against the highway commissioners. Having just been made "wild with rage" by the refusal of the Senate to remove those highway commissioners in order that their removal might profit him by contracts with their successors, he nevertheless now says he refused to help frame them. The writer of that sentence was probably not Stephenson, although he may have signed it. Who prepared the above statement to be given out as coming from Stephenson? Obviously it was written for the benefit of the highway commissioners.

Frank J. Prince, alias Fred Perkins, Publicity Agent for Thomas H. Adams, Editor of the Vincennes Commercial, was one

of the two reporters who charged Mrs. Wheatcraft with giving an interview in which she described poison squad methods. He is a Jew, and a clever reporter. But he was imprisoned five years in the Indiana State penitentiary for issuing fraudulent checks. He was also imprisoned in the Illinois State penitentiary and in the Indiana reformatory, in each case for grand larceny. At the present time, he occupies a desk in the editorial rooms of the Indianapolis Times, the Democratic newspaper that gave greatest prominence to the Adams charges against our public officials.

Because of some of this publicity the Indianapolis Times was sued for libel by the mayor of Indianapolis. One of the attorneys defending the Times is Ralph Kane, who is also one of the deputy prosecutors assisting the Grand Jury in its investigation of the Adams charges. Kane was recommended for this position by the Indianapolis Times. As attorney for the Times, he is thus in secret session with the Grand Jury, and listening to evidence that is not available to the complainant in the libel suit. The Grand Jury has now been in session eight weeks, and has examined one hundred witnesses. Kane has filed his bill with the state for $7,500 for these services with the Grand Jury.

Kane having been one of the prosecutors of Stephenson in the Noblesville trial, was perhaps best qualified to pass upon the documents that Prince was relying upon for his publicity campaign for Adams. These documents were passed around to editors over the state during the summer of 1926. When they asked permission to publish, they were advised that a Chicago paper had first call on the material. The documents were also offered to George V. Coffin, Chairman of the Marion County Republican Committee. He was asked to pay hush money to keep them secret, but declined to do so, saying that if they were genuine, they ought to have publicity.

So through the summer this matter was kept from the public although known to Adams, Republican Editor, to Ralph Kane, Republican Attorney, and to the Indianapolis Times, Democratic newspaper. It was given publicity just a month before the election of November, 1926. The first issue of the Times was early in October, charging a state official with borrowing $275,000 from Stephenson and promising to pay back $825,000. The absurdity of this charge has been referred to in Chapter VII.

There were also rumors that Stephenson was unable, because of lack of funds, to file an appeal from his conviction at Noblesville, for the murder of Miss Oberholtzer. Subsequently, the documents that someone had been trying to dispose of, came into the possession of Adams. At about the same time, Erskine of the Studebaker Corporation of South Bend, announced that he would undertake to finance the Adams Expose' to the extent of $100,000. And about that same time, the attorneys for Stephenson became active and seemed to be provided with funds with which to prepare the transcript for the appeal, which has since been filed.

Reaction against Klan methods is responsible for part of the impetus behind the publicity. But the real basis of the Adams charges grew out of the stories circulated by Samuel C. Hadden,

Secretary of the Indiana Sand and Gravel Producers' Association, as a registered lobbyist on the floor of the 1925 Legislature. He was defending the Highway Commission against the so-called road ripper bill proposed as a reform measure, but which Hadden made to appear was an attempt on the part of Stephenson to gain favorable contracts from the new Highway Commission to be appointed after removal of the former commissioners. This was the poison squad method, used in defense of the Highway Commission.

The connection of Adams and Stephenson with the Highway Commission is told in the Chicago Tribune of October 9, and in the Indianapolis Star of October 8. The State Board of Accounts report which was the basis of the indictments against those connected with the State Highway Commission was published in full in the Indianapolis Star of June 8, 1926. It had been impounded by the Judge of the Criminal Court and was released on petition of the State Examiner, Lawrence F. Orr.

In the Adams interviews it is charged that Stephenson was "wild with rage" because Adams and others defeated the road ripper bill in the Senate in 1925, thus preventing Stephenson from profiting by contracts with the proposed new Highway Commission. Referring again to the last sentence of the Stephenson letter, he says that because he refused to help these highway commissioners, the men to whom he had loaned money, presumably such as the Governor, thereupon secured his indictment for murder because of the suicide of Miss Oberholtzer.

Those who followed the trial of the Stephenson case at Noblesville will bear witness to the fact that the indictment of Stephenson was proper. No one conversant with the details of that trial will charge the Governor nor any one else with doing anything more than was the duty of any state official. Of course Stephenson may have thought differently. But that he could have believed that his indictment grew out of an alleged refusal on his part to help procure the dismissal of the highway commissioners is beyond belief. His interests were all the other way, if any of Adams' charges are to be believed.

In this sentence, therefore, may lie the key to the Adams expose'. The friendship of Adams for the Highway Commission as shown in Chapter VII, his close association with Hadden, also a defender of the Highway Commission, and profiting by its patronage of members of his association, seems to indicate a fabrication of this sentence for the benefit of the Highway Commission. Stephenson may have signed the letter with this sentence in it, but the probabilities are that someone else prepared the letter for his signature.

The sentence may have been inserted to make the document more salable to one in sympathy with the Highway Commission and anxious to help the indicted officials. It may have been done through the instrumentality of Prince, or Asher, who had possession of the documents at that time, or Klinck or Gentry, all convicted or under indictment, and most of them in a position to be helpful to Stephenson, or to co-operate with him.

Who wrote that sentence, so evidently inserted to help win sympathy for the highway commission officials under indictment

on charges originating with the State Board of Accounts? Did Stephenson himself write it? He may have signed it, but surely he did not compose that sentence. Did Prince, clever reporter, and ex-convict, in league with Adams, and Kane, write it? Did Asher, former associate, under indictment in Delaware County for boot-legging and holding possession of some of the Stephenson documents, write it? Did Hadden, who prepared some of Adams newspaper publicity and who was helpful in applying poison squad methods to circulate stories favorable to the Highway Commission? What is the secret surrounding the political alliance of Adams and Kane, Republicans, with Hadden and the Indianapolis Times, Democrats, in defense of the inefficient and suspected State Highway Commission?

This Chapter written in November and published on December 2, 1926, before the Grand Jury has reported, cannot anticipate what its report may be. No information has been available except from newspaper stories. But the statement from the Times of October 6, quoted on the first page of this Chapter, is so evidently written for a purpose that it should never have provoked even a suspicion against the officials charged with malfeasance. The Times published only the vital parts of Stephenson's letter; their "vitality" may have been determined by Prince with the help possibly of the Times attorney. Some of these same charges were later published by the Times in alleged reproduction of Stephenson's handwriting, but the stories were written in the third person, entitled "What Stephenson Could Tell." (Indianapolis Times, October 15, 1926.)

Referring to the quotation from the Times of October 6, the charges are numbered 1, 2, and 3, relating to a prominent official of the State of Indiana, and 4 and 5 relating to the mayor of a large city. These charges have been further detailed in other publicity to show that Governor Jackson accepted a check for $5,000 from Stephenson, which Governor Jackson promptly denied; and to show that Mayor Duvall of Indianapolis made a contract with Stephenson to permit Stephenson to name certain appointees in case of his election as mayor. This latter charge resulted immediately in a suit for libel against those who made the charges. This same story has been circulated by the poison whisperers through the past year but with the beneficiary a favorite of the preceeding administration instead of Stephenson.

In an editorial just published in the Franklin Daily Star of November 10, 1926, the following statement appears:

> "It seems a little more than a coincidence that practically every leader in the spreading of vicious propaganda of suspicion is either a close friend of John D. Williams, director of the highway commission, or of some member of the commission. Thomas Adams, who led in the campaign, has gone about Indiana with the state highway commission members when they were on their official tours and he is understood to have boasted that he is the 'fifth member of the commission.' Others associated with Adams have a connection in one way or another with the state highway body."

(To be continued)

A Short History of the Indiana State Highway Commission

(Continued from Chapter VIII)

CHAPTER IX

As stated in Chapter VII, Adams held frequent meetings with members of the Highway Commission staff throughout the month of October, while he was conducting his campaign for publicity for his charges against the elected officials of the State of Indiana and of the City of Indianapolis. Even Earl Crawford, former member of the Highway Commission, and who was indicted by the Marion County Grand Jury, remains in Indianapolis active in matters connected with the Highway Commission, although his term expired in April, 1926, and he was then succeeded by Robert B. Boren.

Crawford, like Williams, was asked to resign and refused to do so. In the summer of 1925, his highway commission associates put him in charge of the garage, the very department that was instrumental in helping to dispose of government materials without advertising, and for the improper disposal of which he was indicted. Placing him in charge of that department seems in itself an admission that he needed to cover his misdeeds and to prepare his defense. Coupled with the fact that he secreted the inventory of government equipment from the office force, keeping it in his own possession, and the employment of Ashby by the Director to make an audit of the garage accounts for the benefit of the indicted officials, it would seem that Crawford proposes to relinquish little of his former connection with the Commission.

The following letter was received from Crawford under date of October 21, 1926:

"Mr. J. M. Henry,
Indianapolis.

My dear Mr. Henry:—

I have just learned that you are the author of a brief history of the Highway Commission. Being a member of that body for several years I have a deep and abiding interest in its doings, past, present and future. I will regard it a personal favor if you will send me an autographed copy of your work, and I assure you that I will gladly furnish you with any facts that will help you along in your further historical efforts.

Yours truly,
Earl Crawford."

This offer is helpful in showing that Crawford is now Secretary and Treasurer of the Indiana Highway and Motor Association (incorporated) which was organized by Hadden, as outlined in Chapter V, and of which Hadden was formerly the Secretary. Crawford's Board of Directors for this organization consists of John G. Brown of Monon, I. H. Hull of Irvington, Hyatt L. Frost of Connersville, Ray Southworth of W. Lafayette, Walter Crim of Salem, George Wagner of Jasper, Emmett Croxton of Angola, and Ethan Arnold of Elkhart.

Crawford is also influential in the Farm Bureau Federation. W. H. Settle, President of the Federation roomed at Indianapolis

with Crawford and Brown, Chairman of the State Tax Board. (See Chap. IV.) Settle has stated before a Farm Bureau meeting, that he had fully investigated the charges against the Highway Commission, during the past two years, and that there was not a word of truth in the charges. Nevertheless, within six months after Settle made that statement, the five Superior and Circuit Court Judges of Marion County, sitting as a court of claims, found that the $50,000 repaid to the state by Schlensker, as restitution for dealings with the Highway Commission, after exposure by the State Board of Accounts, was properly refunded.

And this was the finding of the court of claims, after the Highway Commission had expended $1800 of the state's money (See page 12, Highway Commission Report for 1925) for a private audit in defense of Schlensker and to discredit the State Board of Accounts in an attempt to show that the $50,000 should have been but $8,000. Schlensker's signed statement when he refunded the $50,000 reads as follows;—

> "I, O. F. Schlensker, state that after being advised by the State Board of Accounts of overpayments made to me for certain parts furnished by me to the State Highway Commission, I offered to reimburse the state for the overpayments, but was advised to wait until the investigation was completed. Later after I had delivered my files to the State House, I was informed by the examiners of large amounts of overcharges, and I then made an offer of $50,000 in settlement of the account. This offer was not then accepted, but in a few days after the offer, I, without solicitation, coercion, or duress, on the part of any one, indorsed to the state of Indiana, a treasurer's check drawn on the Fletcher Trust and Savings Company for $50,000 to be used in settlement of overcharges, freight and express collected, duplicate payments received, and excess war tax collected. This offer was tendered by me as evidence of my good faith to make restitution to the State of Indiana and this statement I sign with full knowledge of the facts, and of my own free will.
>
> O. F. Schlensker."
>
> Signed, June 20, 1924.

The Farm Bureau Federation has just passed a resolution at a recent session, asking that the indicted officials of the Highway Commission be brought to an early trial. This would of course be proper were it not for the fact that a Federal investigation under way has not yet been presented to the Federal Grand Jury soon to meet, and that the county prosecutor is quite fully occupied with his own grand jury investigation growing out of charges instigated by Crawford's friends as a smoke screen for the Highway Commission. It must be conceded for Crawford that he certainly has a deep and abiding interest in the Highway Commission doings, past, present, and future, as stated in his letter, for no member of the commission itself has been more responsible than he for the actual misdeeds of the commission unless it be Chairman Ziegler.

Burch, and Hershman, and Boren who replaced Crawford have been guilty primarily of contributing to the delinquencies by their failure to interest themselves properly and to take

action to remove the Director. As showing the inability of the two older members to understand the highway commission problems, both Hershman and Burch have within the past two months, made addresses advocating legislation authorizing the retention of all of the gasoline tax instead of part of it as at present. They gave as a reason, that the additional funds were needed to meet equivalent Federal Aid funds that thus would increase the total of money available for Indiana roads. That any member of the Highway Commission could thus be ignorant of the true situation as to Federal Aid funds seems almost unbelievable.

The facts are that there is available from the Federal Government approximately $2,000,000 for Indiana each year, conditioned on Indiana's providing an equal amount for Federal Aid roads and bridges in Indiana. Since the State of Indiana supplies its Highway Commission with approximately $13,000,000 a year besides the $2,000,000 offered by the Federal Government, it must be apparent that out of this $13,000,000 the $2,000,000 necessary to meet the Federal Aid fund can be set aside. And no addition to the funds of the Highway Commission through the gasoline tax or any other way can increase the amount that is available from the Federal Government. The portion needed has been set aside regularly and the Federal Aid funds are being used as fast as the Federal Government provides them. For a member of the Commission therefore to say that additional funds are needed to meet the Federal Aid requirements is either gross ignorance or deliberate falsehood.

The State Highway Commission has not only assisted Adams to create a smoke screen for the commission, but it is doing everything possible to build its political fences for the coming session of the Legislature. Director Williams and the two Democratic members have made numerous trips through the Southern part of the State investigating additional roads to be taken into the state system. In return for these roads influential members of the communities affected and particularly newspapers are expected to uphold and contend for any legislation proposed by the commission.

The Honorable Fred S. Purnell, member of Congress, from Attica, the home of Zeigler, Chairman of the Highway Commission, has supported the commission, and in a speech at Crawfordsville on July 28 promised that the Dixie Highway between Crawfordsville and Indianapolis would be paved within a year, and that State Road 33 from Crawfordsville to Covington would be paved within two years. The paving of these two roads, the last named of which runs entirely across Zeigler's home county, will provide a short and almost direct paved route from Attica the home of Zeigler and of Purnell, to Indianapolis. These are the promises made to send Purnell back to Congress and to make Zeigler popular on the Highway Commission. The paving of these two roads means the expenditure of over $2,000,000 not including overhead.

Montgomery County is one of the twenty-five counties of

the state which had never received a single dollar of state highway money for new construction. Her citizens seem to see an opportunity to profit by the situation. Chairman Zeigler hopes to send Congressman Purnell back to Washington through promises that Purnell is able to make on assurances given him by Zeigler. And if Zeigler needs assistance at Washington in alleviating criticism of the disposal of government property improperly, Congressman Purnell may be helpful to Chairman Zeigler. There will be many more promises made of hard surfaced pavements in sections of the state where political support is needed to whitewash the Highway Commission and to induce the Legislature to appropriate additional funds for the use of the commission. This has been the policy of the commission and its Director in the past.

Federal Aid for roads has been particularly misrepresented in attempts to secure funds from Indiana Legislatures. Congress appropriates $75,000,000 yearly to the Department of Agriculture to be distributed to the states by the Bureau of Public Roads. It is apportioned according to area population and mileage of roads in each state, and on condition that each state meeets its share with an equal appropriation for roads to be built by its Highway Commission. The Director of the Indiana State Highway Commission has at times allowed it to accumulate, so that the $2,000,000 annually available for Indiana, could grow into six or eight million perhaps in three or four years, thus forming a basis for argument to the Legislature that an equal amount was needed to make the Federal Funds available. And this argument has been used even when the State has been providing millions in excess of that actually needed to match Federal Aid.

On lettings held this year, bids have been advertised on various roads as State Projects, that is projects on which the State pays all the cost and no Federal Aid is received. Many of these projects are on roads previously laid out and designated as Federal Aid roads, and so approved by the Federal Government as a part of the 7% system. If the State has Federal Aid available for 1926 why are these roads let as State Aid projects instead of using Federal Aid funds? It will be remembered that the appeal of the commission and of its defenders to the last session of the Legislature was for "More funds to match the Federal Aid allotments."

Crawford, while a member of the commission, made a statement in the Indianapolis News of August 11, 1925, in which he said that "the State would just about be caught up with Federal Aid funds by the close of the 1926 construction season." It would seem that such must have been the case before the season was well started, since two projects were advertised and bids received on January 27, 1926, covering the construction of work in the southern part of the state on a road previously laid out and designated as a Federal Aid road and of which the greater part has been built with Federal funds.

(To be continued.)

A Short History of the Indiana State Highway Commission

(Continued from Chapter IX.)

CHAPTER X.

In 1925, an appeal was made to the Department of Agriculture for an investigation into Federal Aid disbursements in Indiana. It accomplished nothing because of the attitude of the Department which is to rely on State Highway Commissions for their information as to conditions in each state. The Federal Aid work in Indiana is supervised by J. T. Voshell, District Engineer, for the Bureau of Public Roads, of the Department of Agriculture. His office is at South Chicago; his residence at Martinsville, Indiana. Martinsville is the only city near Indianapolis that has two state roads leading to it from Indianapolis. This is not necessarily because Voshell resides there, but it may have something to do with the attitude of Voshell towards the use of Federal Aid by the Indiana Highway Commission.

The appeal to the Department of Agriculture was made by citizens of Indiana because of the relocation of the road from Terre Haute to Kentland, referred to in Chapter II. The map of this road is shown on the next page as Figure 1. To provide an extension for the Dixie Highway from Evansville north to Chicago the Indiana Highway Commission have paved continuously from Evansville to Terre Haute with the exception of a few miles south of Vincennes. North of Terre Haute this road would properly have proceeded through Clinton and Newport in Vermillion County in a substantially straight line to Kentland. This location is indicated on the map, Figure 1, as "State Route No. 63 (formerly No. 10.)"

It has now been built, deflected eastward at Lyford, as indicated by the black line marked "Fed. Hwy. No. 41, formerly St. Route No. 9." It passes through Parke County to Rockville and thence north to Attica where it crosses the bridge designed for Fountain County by Titus, former Bridge Engineer and now Chief Engineer, and for which he falsified the voucher for $19,000. Attica, the home town of Chairman Zeigler, is thus made an important city on a main highway, to the disadvantage of Williamsport, and Vermillion County. The cost of new right of way and preparation for paving on the new route exceeded $300,000; there is also upwards of $232,000 for new bridges, not including grade separation still to be executed. The total expenditure for improvement of this road via Rockville exceeded $2,000,000. The new location required so much new earth work

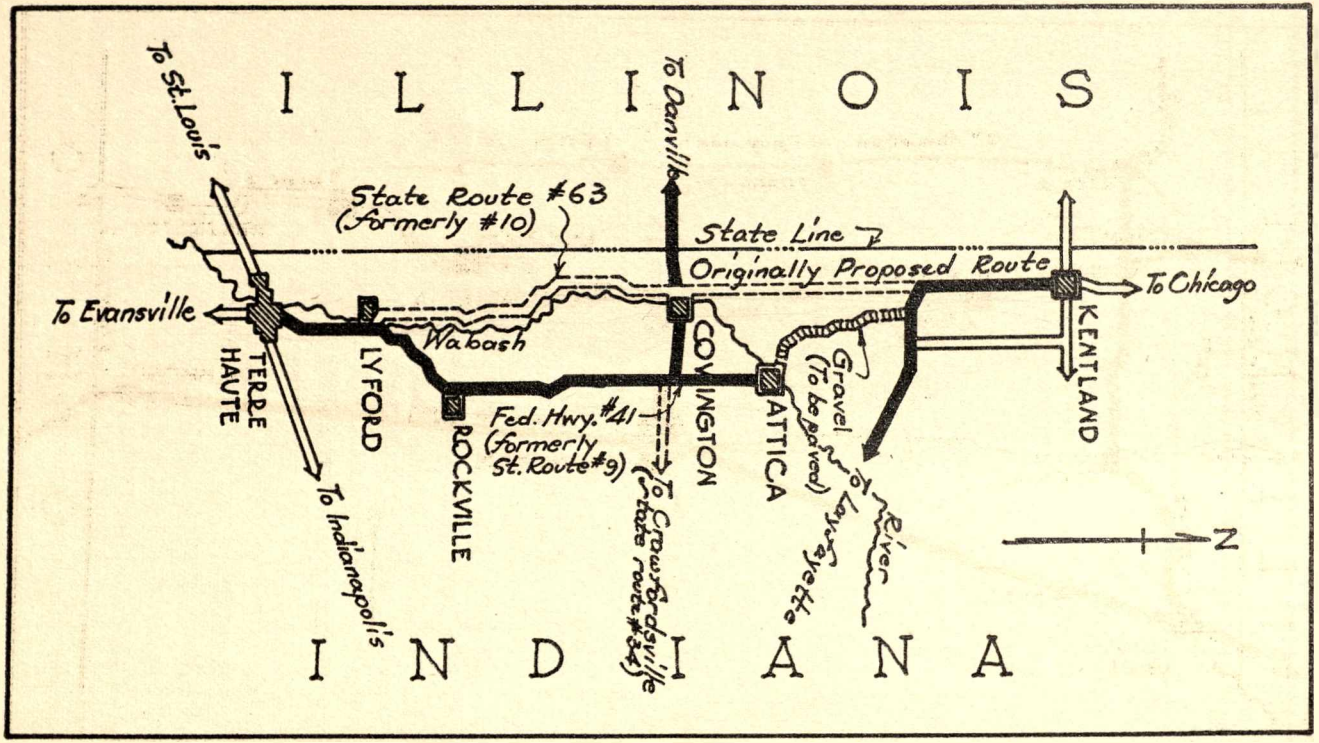

Fig. 1. Showing relocation of Dixie Highway from Terre Haute to Kentland, now deflected eastward at Lyford to pass through Rockville; and Attica, the home of Chairman Zeigler.

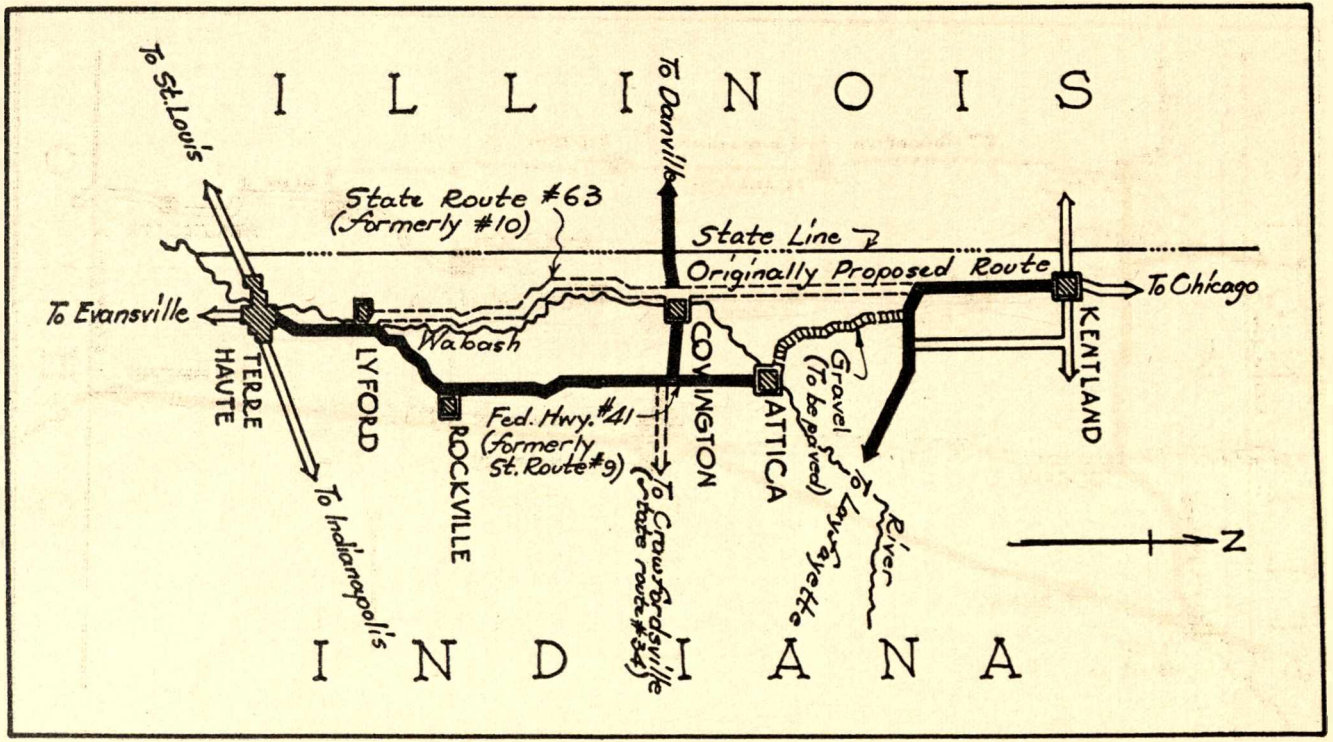

Fig. 1. Showing relocation of Dixie Highway from Terre Haute to Kentland, now deflected eastward at Lyford to pass through Rockville; and Attica, the home of Chairman Zeigler.

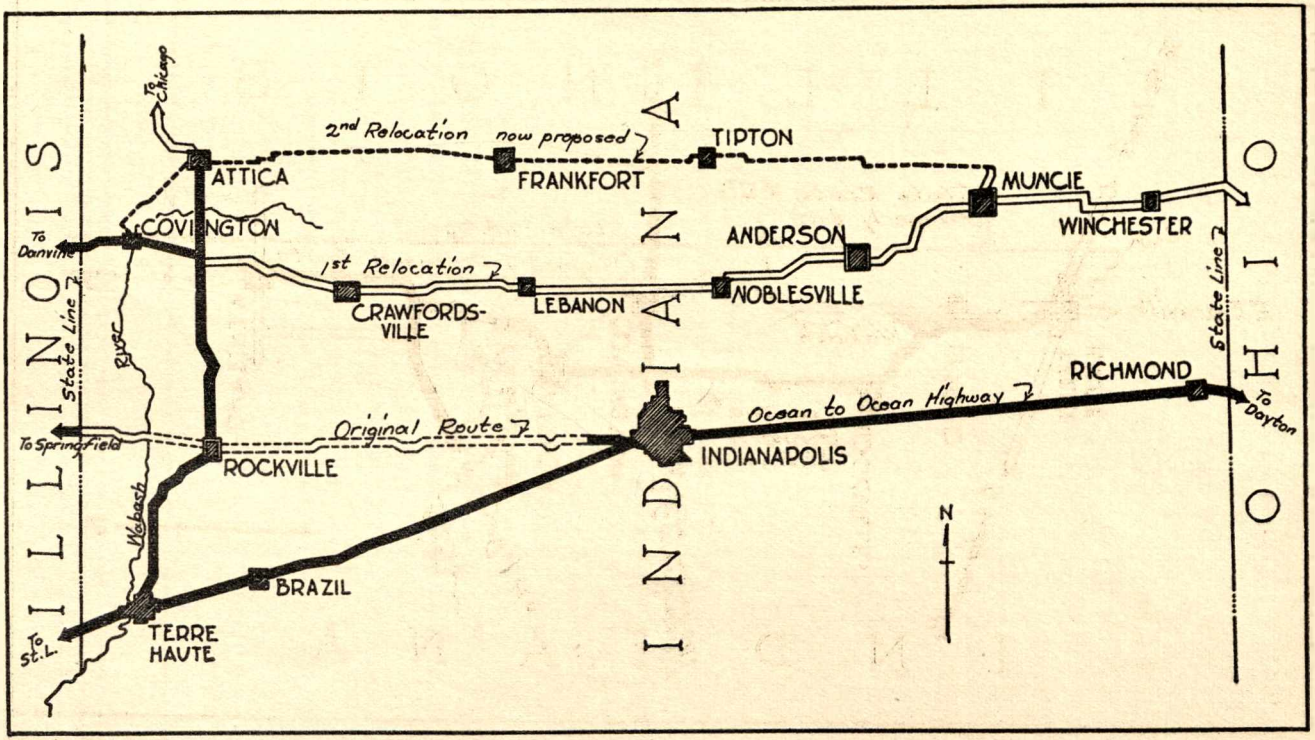

Fig. 2. Showing 2nd relocation of Ocean to Ocean-Pike's Peak Highway, deflected from Indianapolis to pass through Attica, the home of Chairman Zeigler, and Frankfort and Tipton.

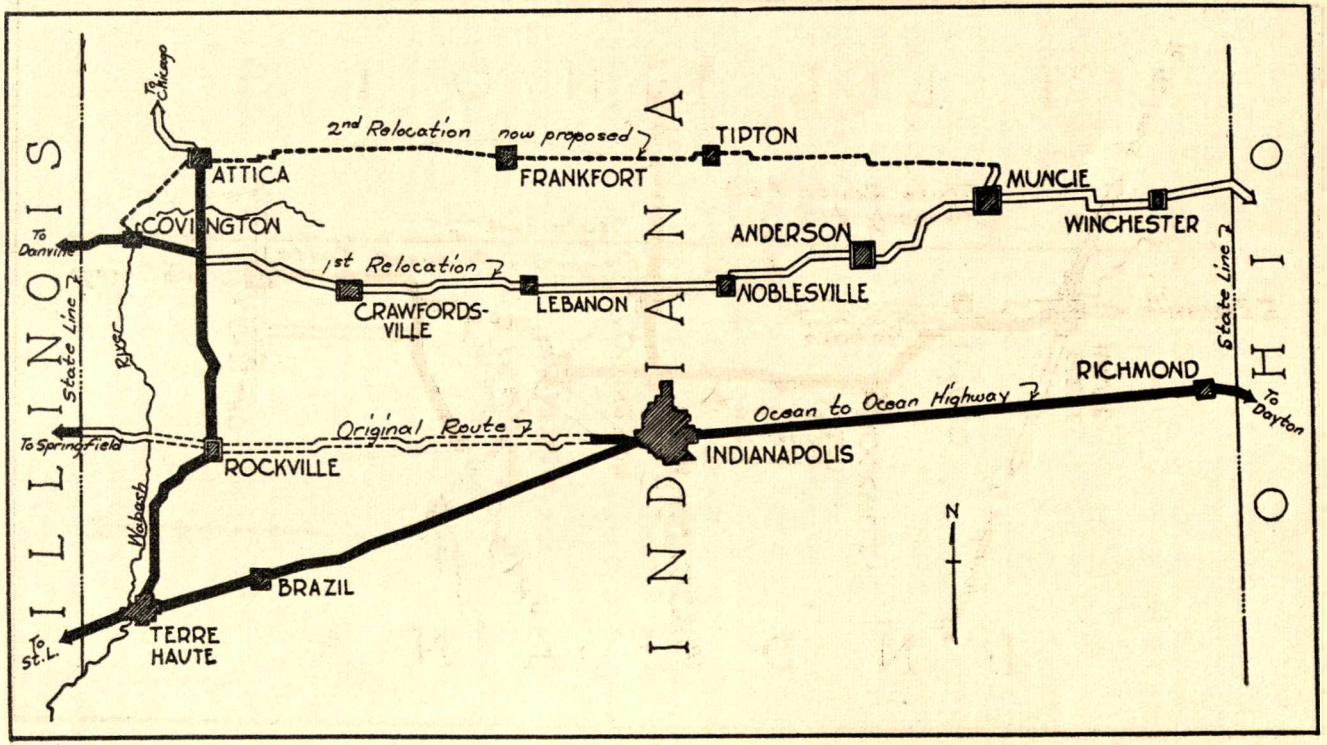

Fig. 2. Showing 2nd relocation of Ocean to Ocean-Pike's Peak Highway, deflected from Indianapolis to pass through Attica, the home of Chairman Zeigler, and Frankfort and Tipton.

in grading and filling that settlements have occurred, badly damaging the new pavement. A large port of the work was done by force account without bids, although the law requires that no force account work may exceed 85% of the lowest bid.

From Springfield, Illinois, the Ocean to Ocean-Pike's Peak highway had been promoted going through Dayton, Ohio, and through Rockville, Indianapolis, and Richmond, in Indiana. The method of promotion was to solicit funds from merchants in the cities through which it would pass, these funds to be used to mark the highway with signs and to induce hard surfacing by highway commissions. After the cities located on this line had thus been canvassed, and a start made for the through direct route as above indicated, this road was shifted northward through Indiana to avoid Indianapolis; it was next located through Danville, Illinois, Covington, Crawfordsville, Lebanon and Noblesville. The routes are shown on the map, Figure 2, as "original Route" and "First Relocation."

The Indiana Highway Commission made plans and representations towards paving first the original location and then the first relocation; subsequently it made a second relocation of this Ocean to Ocean Highway through Attica, Frankfort and Tipton as shown by the dotted line, "Second Relocation," Figure 2. Thus, although the Ocean to Ocean-Pike's Peak Highway, if run in a direct line from Springfield to Dayton, would pass through Indianapolis, it has now been deflected some fifty miles north of Indianapolis to pass through Attica, the home of Zeigler, Chairman of the Highway Commission.

An inspection of the 1926 map of Indiana roads as published by the Highway Commission shows that the place of residence of the members of the Commission may almost be identified by the paving of the highways in their vicinities. Crawford, who resides at Milton, has a paved highway not only from Indianapolis to Richmond, but branching south through Milton and for a short distance beyond. Hershman at Crown Point has numerous paved highways in its vicinity. Burch at Evansville has the Dixie Highway leading north to Terre Haute and another paved highway east. Ft. Wayne, where Zahrt resided, it well supplied with radiating pavements. And Attica, the home of Zeigler, is now to have its east and west pavement, supplementing the north and south Dixie Highway that was diverted from Vermillion County for Attica's especial benefit.

(To be continued.)

A Short History of the Indiana State Highway Commission

(Continued from Chapter X)

CHAPTER XI

The data filed with the Department of Agriculture by citizens of Indiana in protest against the relocation of the Dixie Highway contained the following statements:

> "Adverse criticism has been rife as directed at the flagrant disregard for economy, utility, and honesty of purpose in the locating of the detour of F. A. No. 68 road between Lyford and Kentland. The condition is made unhappily conspicuous by the widespread knowledge that the alternate route through Vermillion County is several miles shorter; is devoid of sharp curves; has but one grading problem; was established a century ago as the Evansville and Lafayette stage road; and by any measure of common fairness, it would have been improved as a part of F. A. No. 68 road.
>
> "The foregoing facts make manifest that authority vested in the office of Federal District Engineer J. T. Voshell, and his subordinates, Messrs. R. H. Harrison and J. W. Moore, at Post Office Building, South Chicago, has been abused. It is believed that unfairness, waste and deceit have marked their administration, that they have failed in their duty of approving rightful locations of roads and instead, have lent influence to the private ends of ex-Governor McCray and Charles W. Zeigler."

The Department of Agriculture did nothing in the matter, except to refer the complaint to the subordinates involved. The road is now built through Attica, the home of Zeigler, Chairman of the Commission. Suit has been filed by Fountain County farmers against the relocation of the Ocean to Ocean-Pike's Peak Highway in an effort to correct such abuses. Whatever the merits of the controversy, and there would of course be advocates for both sides, the examples illustrate the tremendous power that has been placed in the hands of the highway commissioners.

When Crawford was a member of the Highway Commission, he was placed in charge of the Motor Transport department, and submitted a report on pages 156 to 176 of the 1925 annual report. He shows a total expenditure of $945,173.71 for his department, of which $357,850.44 is overhead, amounting to 37.86%. It gives the total number of automobiles owned by the State Highway Commission as 1,321, nearly all received from the Federal Government, but with an average cost to the State of nearly $700 a vehicle for the year.

Mr. Crawford states in his report that a few passenger cars and trucks were secured elsewhere than from the Federal Government. A check of the tables shown, reveals a total of 1,152 vehicles, leaving a difference of 169 unaccounted for, except that 29 cars of various makes were received during the year, one of which is an expensive Marmon limousine for the use of the Director. None of the cars purchased were Studebakers, but since General Manager Erskine of the Studebaker Corporation

came to the assistance of Adams in his attempt to expose political corruption by promising to raise a sum of $100,000, the Highway Commission has bought two new Studebaker cars for the use of its Chief Engineer and an assistant.

For more than a year, or ever since the Marion County Grand Jury returned indictments against Director Williams, Crawford, and others, the Highway Commission has employed John M. Ashby as accountant at a salary of $250 per month in an attempt to check up on the receipt and disposal of this material. Ashby is a close friend of Director Williams and has been working in a private room at the Construction Department office, 16 N. Senate Avenue, with a private safe installed for his benefit. The room is under lock and key and not accessible to the public.

Other inefficiencies in administration are illustrated by the following: In 1924 contracts were awarded for Federal Aid Road No. 66 between Warsaw and Columbia City, the work to be completed by December of that year. A difficulty arose in securing necessary right of way in several places and the State had to resort to condemnation proceedings. Damages were assessed by the viewers appointed by the court, but the Director maintained they were excessive. So he was requested to deposit the amount assessed, which was approximately $6,000, with the clerk of the Circuit Court, in order that the work could be carried on to completion and the matter of damages adjusted later.

This the Director refused to do; the work was not completed within the time limit of the contract, but was carried over into the next season, necessitating the transfer of some 1,400 barrels of cement to another project, the freight charges being several hundred dollars. Material was damaged, and the advantage of the traveling public seriously interfered with. In April of 1925, the Director proceeded to do exactly what he had refused to do months before, and deposited the money with the court. This required the reshipment of materials.

Similar conditions existed relative to right of way on Federal Aid Project No. 74 between Lebanon and Lafayette. Contracts were awarded in 1924 for the paving of this section of the Jackson Highway, to be completed in December of that year. Right of way controversies developed, involving thirteen landowners along this road, due to the relocation of the project. Mr. Willis, who was right of way agent for Chief Engineer Gray, succeeded in settling with nine of the thirteen property holders for $5,735.00 at an average of $308.00 per acre, leaving four tracts in dispute, and could have purchased all for $12,000, but Director Williams refused. Late in the season of 1925, suits were finally filed against these four landowners and damages to the extent of $18,971.00, or an average of $1,661.20 an acre, were awarded by the courts, making a total cost of $24,706.00 for right of way which could have been amicably settled at one time for approximately half that amount.

Through the refusal of the Director to make any reasonable concessions, the State has suffered a loss of about $12,000 plus

construction costs and inconvenience to the public due to the delay in the construction of this important road. This road, the Jackson Highway, is not yet completed, nearly two years after contract expiration. For a year after the pavement was laid, the bridges were being built, with "slow" signs and detours, and now two years afterwards, the detours are still in effect for part of the above right of way. It became necessary to release the contractor on one section of this road and to assume all responsibility for some 3,200 barrels of cement in storage, much of which was damaged.

In striking contrast to these cases above noted, is that of Project No. 79-A, just south of Attica, the home of Chairman Zeigler of the Commission. Suit was filed immediately against one property owner and damages to the extent of $8,500 were appraised, yet the Director did not hesitate to deposit this money with the court and permit the work to go forward. Months afterwards the suit was adjusted for $2,600 and the balance was returned to the Commission by the court.

Another instance is that of Federal Aid Project No. 31-A on the Dixie Highway where considerable delay was caused by the Director's negligence in securing right of way. By reason of this difficulty and others, the contractor filed claim for damages and threatened suit against the State. In the final settlement, after various meetings with the attorneys, the contractor was allowed extra compensation to the extent of everal thouand dollars based on an "extra work agreement" when no such agreement had ever existed, but was drawn at the time of final settlement, and made a part of the same.

In the Wright case, in which judgment has just recently been rendered by the Court, for $22,000, against the Highway Commission, the inspector, Zocholl, classified certain excavation as rock. It was proved in court that the material had been blasted, some of the blasting actually damaging property. Nevertheless, Director Williams and Chief Engineer Titus reclassified the excavation as earth after five estimates had been passed for rock. The court held that Williams and Titus were wrong, and that the material should have been paid for as rock.

In the case of the Granite, Sand and Gravel Company vs. Davis Construction Company, an attempt was made by the defendant to resist payment for materials delivered on the ground that the amount claimed was not delivered. The attorney for the defendant was Kane, who is now defending the Indianapolis Times in the libel suit resulting from its publication of Adams charges a month before the November, 1926, election. The inspector for the Highway Commission testified that he had had no experience when put in charge of the work, had never seen a concrete mixer at work, and that sand and gravel are usually measured in sacks. This inexperienced inspector testified that he did not know the number of cubic feet in a cubic yard.

In the Scott case, now pending, Director Williams told the attorneys that it was ridiculous to assume that the center of the road could have been moved over 24 feet. His subordinate,

Hallet, was called in and said it was correct that the road had actually been moved 24½ feet. Such are a few of the charges of incompetence against the Director of the Highway Commission. Nevertheless, newspapers now carry the word that the Commission has raised the salary of Director Williams to $7,500 a year. The Budget Committee finds that it has no jurisdiction and that the matter is wholly in the hands of the Highway Commission.

And so Director Williams retains his position, refusing to resign. On his recommendation, the Highway Commission employs men to secure favorable publicity and to cultivate influential friends for the Commission. There are men who say they are working for the Highway Commission who perform no useful service and who may be to that extent padding the payroll. On some of the maintenance work in the state, the State Board of Accounts has discovered on the payroll the names of men long since dead and their employers profiting by checks issued in their names. When the state does construction work by force account, that is, by employing its own men and buying its own materials without competition, as was done on the Dixie Highway through Attica, the incentive for such padding of payrolls is tremendous.

When McCray was Governor, he promptly secured the resignation of Director Wright because he was carrying a revolving fund in his own name at the Aetna Trust Company for the purpose of paying weekly payrolls. Because of this, Director Wright submitted his resignation when asked. Director Williams is carrying a similar revolving fund of $75,000 at the Bankers Trust Company, and, although his resignation has been asked, he has refused to give it.

The Indiana State Highway Commission is the most important department of the State Government. It spends $15,000,000 a year, or approximately $40,000 a day for every day of the year. This is nearly 100 times as much as the amount expended by any other Commission, is approximately 35 times as much as the amount expended by any other department, and is several times the amount expended by any other state institution, such as Purdue University. The State Highway Commission has over 2,000 employees and over 1,300 automobiles, and thus has access to every part of the state. It is in a position at any time to influence the sending of large numbers of letters and telegrams to members of the legislature to control their actions. It has almost become greater than the State Government itself.

(To be concluded.)

A Short Story of the Indiana State Highway Commission

(Concluded from Chapter XI)

CHAPTER XII

The intention of our forefathers to establish a government having three departments, executive, legislative, and judicial, has been much modified of late years by the criticism that such government is controlled by politics. To prevent political control, commissions have been created and have been protected from alleged political control by such devices as overlapping terms for their members. In the State Highway Commission, four members are appointed, one each year for four years. Thus three-fourths of any governor's term would have expired before he could appoint a majority. The Director of the Commission is chosen by the Commission and can be removed only by the Commission. He is not subject to removal by the Governor. The Commission, therefore, acts as a cushion between the Executive and the Director on the theory that thus political control can be prevented.

That this has not been the result is shown by the fact that Hadden, Secretary of the Indiana Sand and Gravel Producers' Association, is actually more influential in highway commission matters than the Governor of the State himself. No one is more responsible for the stories that have been circulated against the Governor, than Hadden.

It is a fact that this machine is running away with the State Government. It is this machine which inspired the charges made by Adams and "his motley crowd, who under the guise of ferreting out graft, are seeking and acquiring wealth and hoping to gain political ascendency." The Indianapolis Times, today, admits that this investigation is likely to result in no indictments by the Grand Jury after ten weeks of investigation. The Indianapolis Times ought to know, for its own attorney, Kane, is one of the Grand Jury investigators. This investigation started out with high hopes in the middle of October; the Grand Jury has undoubtedly made an earnest effort to uncover the scandal alleged to exist. It seems to have discovered nothing, and the Indianapolis Times is now making its apologies for its failure by charging that certain of the witnesses were out of the state, although so far as known, everyone has ultimately been heard. The term of the present Grand Jury ends December 31, 1926. A new Grand Jury is then empanelled.

And in the meantime, the State Highway Commission with an expenditure of over $72,000,000 has completed less than 1,000 miles of pavement, less than the amount of pavement today in Indianapolis alone; this is approximately one-fifth of the total required by the State system, provided wider pavements are not demanded, in the thirty years that will be necessary to complete the State system, if continued at the same rate. During the past year, only 179 miles of hard surfaced pavement have been

completed. This is the least of any year, although with the greatest expenditure. In 1924, 215 miles were completed, in 1925, 200 miles, and in 1926, 179 miles. Yet, the total of expenditures increases, as the mileage decreases.

Indiana is paying as she goes for her State Highway system. She issues no bonds. Her counties and townships have built their highways largely by bond issues of which there are now a total of $73,000,000 outstanding. Half of her 75,000 miles of county and township highways are gravelled or hard surfaced. If the 5,000 miles of the state system constituting 7% of the total can be made hard surfaced without waste, Indiana will rank high in the possession of an excellent highway system. It will require at least twenty years to do it and for every mile wasted there will ultimately be two to pay for. And the burden of expense is bound to increase as the years go by. Fortunately we shall hope to have progress in wealth and ability to pay as we go forward. But we must also eliminate waste for this is a part of the progress that is demanded to increase our wealth.

The business of the Indiana State Highway Commission, although a public business, is not conducted for the benefit of the public. It is only with the greatest difficulty that the State Board of Accounts can check the expenditures. Because of the form of organization of the Highway Commission, it has literally become an inefficient, overgrown department of the state, endeavoring with all its power to prevent exposure and reform, and becoming more and more inefficient as it is compelled to waste its activities in its own defense.

It is well described by Lockwood's "Government in Business" in which he concludes "it would ultimately increase costs and lower standards of service. It would build up a huge office-holding craft which would be in a position to control the government to its own interests, destroying plans for improvement, and create an irresistible political and business machine which, unlike private business enterprises, would be beyond the control of the Government, because it would itself be the government."

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The Roads and Road Materials of a Portion of Western Indiana.

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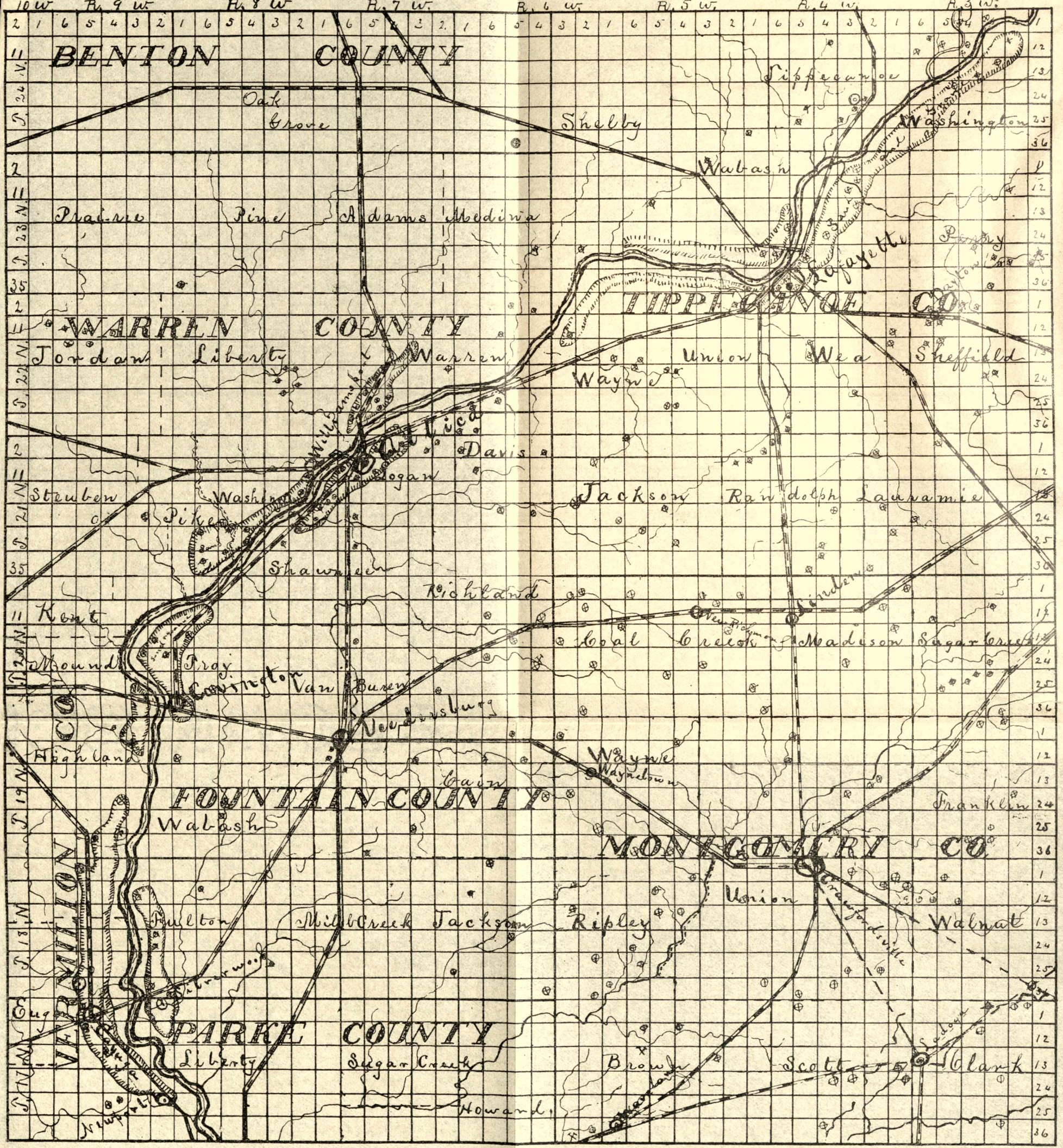

FIG. 41B. ILLUSTRATING THE DISTRIBUTION OF ROAD MATERIALS IN TIPPECANOE, WARREN, FOUNTAIN, MONTGOMERY AND PARKE COUNTIES.

LEGEND

- Sand and Gravel Terrace
- ⊗ Gravel Pits
- X Stone Quarries.

SECTION IX.

THE ROADS AND ROAD MATERIALS OF A PORTION OF WESTERN INDIANA.

EMBRACING THE COUNTIES OF TIPPECANOE, WARREN, FOUNTAIN, MONTGOMERY, VERMILLION, PARKE, VIGO, CLAY, SULLIVAN AND KNOX.

BY J. T. SCOVELL.

The counties above mentioned whose road materials are treated in this section are in the valley of the Wabash and, excepting Clay and Montgomery, they border on that river. The Wabash rises in the central-western part of Ohio and flows northwesterly to Huntington, in northeastern Indiana, thence southwesterly to the region of Covington, in Fountain County, thence southerly into the Ohio River. From its source to Huntington the river occupies a recent or post-glacial channel, with banks and bed of drift materials, having no bluffs, terraces nor flood plains. Below Huntington the river follows the old Erie-Wabash channel, that formerly carried the surplus waters of Lake Maumee.

For much the greater part of its course this old channel follows an ancient preglacial channel that has been partially filled with glacial drift. In the northeastern part of Fountain County the river flows for a few miles in a recent channel with bed and banks of rock. The same is true at Delphi, in Carroll County, at Logansport, and at other places. It is supposed that some obstruction, probably masses of glacial drift, forced the old Erie-Wabash to take shorter courses and cut new channels across the necks of curves in the ancient channel. From Attica, in Fountain County, southward there is no doubt about the preglacial channel. From Huntington the valley of the Wabash, including flood plains and terraces, is one to three miles wide, spreading out in some places, as in Vigo County, to a width of five or six miles. The flood plain is from a half mile to two miles wide, reaching

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in some places a width of three or four miles. This flood plain rises from 8 to 20 feet above low water in the river, and is usually composed of silt, clay and fine sand, but sometimes the great body of the plain is heavy gravel covered with a thin layer of silt, as in the southern part of Vigo County. In general the fine silts characteristic of the flood plain rest on the masses of sand and gravel that form the bed of the river.

The river zigzags across the flood plain from bluff to terrace and terrace to bluff, cutting the plain up into sections of different lengths. The terraces rise from 15 to 75 feet above low water in the river, and are generally composed of sand and gravel. Sometimes what seems to be a terrace is really a rock shelf, sandstone, limestone or shale. The old river that formed the terraces zigzagged across the ancient channel from bluff to bluff, so that the terrace is cut up into sections. At Williamsport, in Warren County, the river flows along the bluff on the west. At Portland, in Fountain County, it flows along the bluff on the east. In the southern part of Warren County the river, or its flood plain, has again shifted to the bluff on the west, and the terrace is on the east. Below Covington the river flows near the east bluff, and the terrace is on the west. Below Newport the river has again crossed to near the west bluff and the terrace is on the east. At Lyford, in the southern part of Parke County, the river is near the bluff on the east and the terrace is on the west. Through Vigo County the river is nearer the west bluff and the terrace is on the east. In the northern part of Sullivan County the river flows near the bluff on the east and the terrace is on the west.

The terraces at Cayuga, in Vermillion County; at Montezuma, in Parke County, and at Terre Haute, in Vigo County, seem to occupy basins or wide places in the ancient channel. Along the bluff in the northern part of Parke County, at several points in Vigo County, and in the northern part of Sullivan County, there are sand dunes and great deposits of wind-blown sand. These dunes seem to indicate that the ancient channel must have been occupied for a long period of time by a lake or a sluggish stream. Deep wells at Lafayette, Attica and Terre Haute show that there are at least 100 feet of sand and gravel between low water in the river and the bed of the ancient channel. Deep wells in the

terrace at Terre Haute and tests made for gravel show in general rather coarse gravel at or near the surface, while the lower portions are of sand or much finer gravel. This arrangement suggests a delta formation. It is interesting to note that the sand and gravel in the terraces are stratified but not well assorted, fine sand and coarse gravel stones occurring together, often associated with large boulders and sometimes with angular fragments of coal and shale and masses of boulder clay.

At many places in Warren, Tippecanoe, Montgomery, Clay and other counties old channels and basins have been partially filled with sand and gravel, and these materials then covered with prairie soil or with boulder clay of varying thickness. In Jordan Township, Warren County, on sections 7, 8, 17 and 18 (22 N., 10 W.), there is a deposit of "water gravel" having an area of at least 1,000 acres. The gravel is from 10 to 15 feet thick and is covered with from 3 to 6 feet of prairie soil and clay. Such gravel deposits are usually filled with water. In the northern part of Clay County there is a preglacial channel that has been partly filled with sand and gravel, and these covered with boulder clay from 5 to 30 feet deep. In a mine at Fontanet, Vigo County, they found a little stream bed with sand, gravel and boulders covered 100 feet deep with boulder clay.

In Tippecanoe, Fountain and Montgomery counties there are irregular gravel ridges that seem to be eskers, and hundreds of little mounds or hills of sand and gravel that are perhaps kames. Shawnee Mound, in southwestern Tippecanoe County, is thought to be a kame, and a long gravel ridge north of Romney, in the same county, is a good illustration of an esker. But many gravel deposits that look like kames when investigated are found to extend far below water level, filling some old channel or basin. Thus we may find a gravel deposit whose base and body is subterranean or water gravel with a summit of kame gravel. About Lafayette and Attica these kame-like deposits cover the face of the bluff and blend with the terrace so as to greatly obscure the features of each.

There are also quantities of good gravel in the streams. This gravel may come from the terraces, may come from disintegrating boulder clay, but perhaps more largely from little pockets of gravel

distributed irregularly through the boulder clay. In Tippecanoe and Warren counties gravel and boulder clay are frequently interstratified, the clay being sometimes the more abundant and sometimes the gravel forming the thicker beds. These masses of sand and gravel are supposed to have been deposited by the glacier, but in general the forms have been largely determined by running water. As the glacier moved slowly southward, the summer floods, the streams from the wasting ice, filled many of the old channels and basins with sand and gravel, much as a delta is formed, the finer materials in general below, the coarser above, but the materials in the upper portions are seldom well assorted. The advancing ice gradually covered these deposits, protecting them somewhat from erosive agencies. As the glacier retreated the materials of the drift covered the deposits of gravel. In some cases the summer floods carried away the drift and often large quantities of the gravel. In other cases the sand and gravel remained undisturbed under its cover of drift materials. Recent drainage channels, cutting down into the drift, occasionally disclose some of these hidden masses, or it may be that a well or a mining shaft reveals the presence of these buried gravels.

The interstratification of clay and gravel may perhaps be explained by a second advance of the ice, or by alternate advances and retreats of the ice for a few miles, on account of changing climatic conditions. Eskers, kames and similar forms of drift are possibly divisible into two classes; first, those that stand on boulder clay and are probably the products of the last advance of the ice, perhaps formed while the glacier was building the Shelbyville moraine; second, those that stand in old channels or basins, seeming to be products of the first advance of the ice, modified in form by later ice, and perhaps surrounded with boulder clay, but not covered by it. The sand and gravel of the region under discussion is therefore seen to be abundant and to exist under a great variety of forms and circumstances.

In general the sands and gravels of this region are of glacial origin. They are for the most part derived from broken-down granite, sandstone and limestone rocks. The sand, especially the finer sands, are nearly pure quartz. This quartz may have been derived from disintegrating sandstones or granitic rocks, or from

geodes of limestone rocks. In the coarser sands and finer gravels, diorite, felsite, granitic and limestone grains occur, and in the coarser gravels they make up the bulk of the mass. Fully one-half of the quartz in the coarser gravel is derived from geodes. A large per cent., often as much as 25 per cent. to 35 per cent., of the pebbles in coarse gravel are of limestone. These limestones may be solid and of good quality and may help cement the mass together, but they can not compare with the granites in capacity to resist a crushing force.

Almost everything called gravel is used for road building. In general bank run material contains too much sand for first-class road metal. In some places rock has been used in road building, but there are no profitable quarries in the region covered in this report.

TIPPECANOE COUNTY.

Area in square miles	488
Population in 1900	38,659
Miles of public roads	825
Miles of improved roads	400
Percentage of roads improved	48.4
Miles improved with gravel	400
Miles improved with crushed stone	None
Average original cost of gravel roads per mile	$850
Total original cost of improved roads	$340,500
Annual cost of repairs per mile on gravel roads 5 years old	$50
First improved roads built	1868
Proportion of improved roads built since 1895 (per cent.)	5
Satisfaction of farmers with investment in improved roads	Good
Authority	H. H. Cheney, County Auditor

Tippecanoe County is in the western central part of the State. It is bounded on the north by Carroll and White counties, on the west by Benton, Warren and Fountain counties, on the south by Montgomery County, and on the east by Clinton and Carroll counties. The county comprises townships 21, 22, 23 and 24 north, in ranges 3, 4, 5 and half of 6 west of the second meridian.

The Wabash River flows across the county and its valley is the dominant feature in the topography of its area. The river enters the county at the northeast corner and flows southwesterly to near the center, then westerly to within about two miles of the

west line of the county, thence southwesterly, crossing the county line about ten and a half miles north of the southwest corner. The surface of the county for the most part slopes toward the Wabash, and the smaller streams of the county all flow into that river.

Tippecanoe River enters the county about three and a half miles west of the northeast corner and flows into the Wabash after a course of about six miles in the county. Other streams from the north are Burnett's Creek and its branches, Big Indian Creek and its tributary, Little Indian Creek, and Little Pine Creek, which flows into Warren County. From the southeast and south the chief tributaries are Sugar and Buck creeks, which rise in Carroll County. Wildcat Creek and its branches drains the southeastern part of the county, Wea Creek drains the central southern part, and Flint Creek drains several sections into the Wabash near the west county line.

The elevation of the Wabash at Lafayette is about 500 feet, and the bluffs about Lafayette rise about 230 feet above the river. Probably few if any points in the county rise more than 800 feet above tide.

Sand and gravel are abundant in Tippecanoe County. There are immense quantities of sand and gravel in the banks and bed of the Wabash River and great quantities along the Wildcat and Wea creeks in their lower courses. In the southern portion of the county there are immense deposits of esker gravel. There is also considerable stream gravel and some morainic gravel. In addition there are some gravel deposits of unknown extent buried under thick beds of clay.

Tippecanoe Township.

In Tippecanoe Township, in the northeastern part of the county, there is considerable gravel in the second bottoms and bluffs of the Wabash and Tippecanoe rivers. Tyler Hill, on section 3 (24 N., 3 W.), is a gravel deposit in the bank of the Wabash. Leffler Hill, on the southeast quarter of section 5, is a gravel deposit in the bank of the Tippecanoe, and Hog Point Hill, in the north half of section 9 is also a gravel deposit of considerable extent. The Booth gravel pit, on the northwest of the southeast of section 9, is perhaps in the Hog Point Hill deposit. The gravel in these localities is of good quality. There are a few boulders

and 30 to 40 per cent. of sand, but bank run material makes good roads. No definite idea could be gained of the area of these deposits except that they are large, many acres in extent. The covering of soil or clay is generally very thin, seldom more than 12 to 30 inches, so that the gravel is easily accessible.

The gravel at Hog Point Hill is from 20 to 30 feet thick, resting on heavy beds of blue clay. I found no place in this region where the gravel deposits reached water level. They appear to be bluff deposits. The Skigley gravel pit, on the east half of the northeast quarter of section 8 (24 N., 3 W.), is in a deposit of at least five or six acres, and there is a face of about 20 feet exposed. Nothing definite is known about the depth. The soil covering is very thin, being only a few inches. The gravel is of good quality with a few boulders and considerable sand intermingled. There is some cemented gravel in the bank, but it does not occur in large masses, so it does not seriously interfere with the working of the pit.

The Sterrett gravel pit, on the south part of section 7; the Smith pit, on the northeast quarter of 7, and a pit in the southwest quarter of 5 (24 N., 3 W.), each furnishes good gravel. In general there are only 12 to 15 inches of soil over the gravel. Nothing definite is known as to the area of these deposits, but there are doubtless several acres in each. There are only 10 to 15 feet of gravel exposed in these pits, but the deposits are claimed to be at least 20 to 30 feet thick.

In the 15th Annual Report of the Indiana Department of Geology Prof. Gorby gives sections of a large number of wells. Some of these sections give information in regard to the distribution of gravel in this region as follows: A well at the residence of Mr. John Gross, on the southwest quarter of section 4 (24 N., 3 W.), near Leffler's Hill, shows:

Section of Gross Well.

		Feet.
1.	Soil	6
2.	Gravel	40
3.	Gray clay	10
4.	Gravel	10
	Water at	66

About the level of the water in the Tippecanoe River.

A section of M. L. Thomas's well, on Moats Creek, northeast of the northwest of section 8 (24 N., 3 W.), not far from the Sterrett and Smith gravel pits, shows:

Section of Thomas Well.

		Feet.
1.	Soil and clay	4
2.	Gravel and sand	20
3.	Hardpan	20
4.	Sand and gravel	25
5.	Gray clay	2
	Total	71

The section of Newton Smith's well, on the south line of section 6 (24 N., 3 W.), near the Smith gravel pit, shows:

Section of N. Smith's Well.

		Feet.
1.	Soil	2
2.	Sand	28
3.	Blue clay	50
4.	Coarse gravel	5
	Total to water	85

Mr. Smith says it is common to find water in the gravel below the clay. These gravel deposits are exposed in the bluffs of streams in some cases clearly resting on beds of clay. The well sections indicate that sand and gravel are somewhat widely distributed in this region; that the deposits are from 20 to 40 feet thick, resting on thick beds of clay or hardpan, and that below the clay there are also extensive beds of gravel.

The town of Battle Ground is located on section 23 (24 N., 4 W.). It stands on a terrace of clay, sand and gravel. The latter seems to be abundant, yet only a few pits have been opened. The Fisher pit, on lot 3 of Burnett's reserve, and others on lots 1 and 2 of the reserve, are just east of town. The gravel is of good quality but contains considerable sand. N. Klossen has a pit on the southwest quarter of section 27 (24 N., 4 W.), just southwest of town. It furnishes good road material. A section of J. M. Hicks' well at Battle Ground, as given by Prof. S. S. Gorby, shows:

Section of Hicks' Well.

		Feet.
1.	Soil	3
2.	Hardpan	3
3.	Gravel and sand	73
	Total	79

A section of J. P. Clute's well shows:

Section of Clute's Well.

		Feet.
1	Soil and clay	4
2.	Coarse gravel	25
3.	Sand	30
4.	Blue clay	1
	Total	60

A section of the bluff of Burnett's Creek, north of Battle Ground, as given by Prof. Gorby, shows:

Section of Bluff of Burnett's Creek.

		Feet.
1.	Soil and yellow clay	10
2.	Fine sand	30
3.	Blue clay	50
	Total	90

Another section of the same bluff shows:

		Feet.
1.	Yellow clay	40
2.	Gravel	50
	Total	90

The section of John Livingstone's well, on the northeast of the northeast of section 28 (24 N., 4 W.), about two miles west of Battle Ground, shows:

Section of Livingstone Well.

		Feet.
1.	Soil and yellow clay	30
2.	Dry sand, fine	20
3.	Blue clay	30
4.	Cemented gravel	2
5.	Loose gravel	13
	Total to water	95

The section of James Bryant's well, on the west half of the northeast quarter of section 29, about three miles west of Battle Ground, shows:

Section of James Bryant Well.

		Feet.
1.	Soil and yellow clay	4
2.	Blue clay	50
3.	Dry sand	20
4.	Coarse gravel	2
	Total to water	76

There is a good gravel pit on Mr. Bryant's place. Mr. A. P. Catherwood, on the east half of the southwest quarter of section 29 (24 N., 4 W.), also has an abundance of good gravel. There are about 15 feet of gravel exposed in the pit, with not much sand. P. G. Smith, in the east half of the northeast quarter of section 9, has several acres of good gravel. Material from this deposit was used in making the Brown gravel road along the east line of sections 4, 9 and 16 (24 N., 4 W.). Gravel is found at several places in the banks and bed of Burnett's Creek, which drains the western portion of Tippecanoe Township.

Wabash Township.

Along the river in the edge of the terrace on sections 8, 17, 18 and 19 (23 N., 4 W.), there is an abundance of sand and gravel. Nothing very definite is known as to the extent or depth of the deposit, but it is supposed to be several hundred acres in area, and from 50 to 75 feet below low water in the river. The Catherwood pit, on section 19, yields large quantities of excellent sand and gravel. Occasionally great masses of cemented material occur. The Big Four Railway and the Lake Erie Railway have extensive gravel pits on sections 30 (23 N., 4 W.), and 25 (23 N., 5 W.), just south of the Purdue University grounds. Great quantities have been taken out for the use of the railways, as well as for shipment. These pits furnish good road material.

The Pierce gravel pit, on the northwest quarter of section 36 (24 N., 5 W.), is in a deposit of four or five acres, which shows soil and clay 4 to 6 feet and sand and gravel 8 to 10 feet, to water. This pit furnished gravel for the Lyman gravel road and

others in its neighborhood. In the northern portion of the township there is very little gravel. I could not learn of any workable pits.

Miller's pit, on the southwest of the northeast of section 3, and Gaylord's pit, on the southeast of the northwest of 3 (24 N., 5 W.), are in a deposit of unknown depth and area. The section exposed is:

	Feet.
1. Soil and clay	2 to 3
2. Sand and gravel	5 to 6

to water. With a scoop in the Miller pit they took out gravel to a depth of 34 feet below water level, without reaching the bottom of the deposit. This gravel is in the valley of Indian Creek and is thought to be several acres in extent. The material is rather fine, containing about as much sand as gravel, but it is considered good road material, and has been used in improving most of the roads in the central portion of the township. There is some gravel along the streams in the north and in the southern portion. Bole's pit, Kidwell's pit, and Cole's pit may be mentioned, but they are not considered of much importance.

There is thought to be an abundance of gravel in the southwestern part of the township, but little has been developed.

Shelby Township.

The northern portion of this township has no good gravel pits. The material for improving the roads of this portion of the township came largely from the Judd pit in White County. The gravel roads in the central portion of the township were made with gravel from the Gaylord and Miller pits in Wabash Township. In the western central portion several deep wells show:

	Feet.
1. Soil and clay	20 to 25
2. Sand and gravel	20 to 80

It is quite possible that in some localities the sand and gravel may be so near the surface that it might be taken out with profit, but no such localities have been discovered, unless Gaylord's

and Jordan's pits, and other deposits along Indian Creek, are such localities uncovered by the work of running water.

In the southern portion of the township in the river terraces and along the bluffs of Indian Creek there is an abundance of gravel. The Indian Hill pit is in the bank of Indian Creek on the north half of the northwest quarter of section 17 (23 N., 5 W.). As opened the pit shows:

		Feet.
1.	Soil and clay	2 to 4
2.	Gravel	18 to 20

It is called good road material. Large quantities of gravel are shipped from this pit to points in the northeastern portion of Warren County.

Washington Township.

This township, lying in the northeastern part of the county, has plenty of gravel. In general along the river bluffs there is sand and gravel and boulder clay. Peter Ritterath has a good gravel pit on the northeast quarter of section 31 (24 N., 3 W.). It is several acres in extent and shows soil and clay one to three feet, gravel exposed 15 to 20 feet. There is considerable fine sand in the deposit, but it is called good road material. George Frida has an abundance of gravel on the northeast quarter of section 20 (24 N., 3 W.). It is of good quality, perhaps a little coarser than that in Ritterath's pit, and makes a good road.

On the southeast of the northeast of section 16 there is a large body of good road material, containing some fine sand and a few boulders. On the northwest of the northeast of section 15 there is a large deposit of gravel and sand. There is but little very fine sand and but few boulders. This deposit consists of several acres and is perhaps 20 feet thick to the level of a little creek. The section exposed contained a large per cent. of coarse gravel. The Culp gravel pit, in the northeast of the southwest of section 11, yields an abundance of good road material. There is also some good gravel along Sugar Creek.

Buck Creek Station is on the northeast corner of the northwest quarter of section 33 (24 N., 3 W.). A section of a well, given by Prof. Gorby, shows:

Section of Well at Buck Creek Station.

		Feet.
1.	Soil and yellow clay	5
2.	Blue clay	15
3.	Fine yellow sand	30
	Total	50

Another section by Prof. Gorby, about one mile west of Buck Creek, shows:

Section One Mile West of Buck Creek.

		Feet.
1.	Soil and yellow clay	6
2.	Gravel and sand	49
3.	Blue clay	5
	Total	60

East of Buck Creek are the Buck Creek bottoms, a flat, prairie like country with deep black soil. Wells in this region, according to J. C. Eckhart, show:

		Feet.
1.	Black soil about	6
2.	Quicksand about	20
3.	Blue clay	6
4.	Sand or gravel	10+

Perry Township.

This township lies south of Washington, and corresponds to township 23 north, range 3 west. The North and Middle branches of Wildcat Creek flow across the township from the east, uniting in section 18 near the western boundary. The surface along these streams is much broken, exposing many deposits of gravel, some of considerable size.

Blinkenstaff's pit, on the northeast of the southwest of section 11, is in a deposit of 5 or 6 acres in extent. An exposure in the bank of a little creek shows soil and clay 1 to 3 feet and good gravel 18 feet. There are small deposits at other points along the North branch of Wildcat Creek. On George Griffith's place, in section 7, there is a large deposit of gravel extending on to other farms. It is a good material and is perhaps the largest deposit in the township.

On the northwest quarter of section 21 Owen McCormick has 8 or 10 acres of gravel in the bluff of the Middle branch of Wildcat Creek. Where it outcrops in the bluff there is but little stripping, but back in the hill there is 10 to 15 feet of soil and clay over the gravel, so that there are probably not more than 2 or 3 acres that can be worked at a profit. There are only about 10 feet of gravel exposed in the pit, but it is thought to extend much deeper, a thickness of 25 to 30 feet being claimed. It appears to be of very good quality. Frank Eagleshoff has also a deposit of good gravel on the northwest quarter of section 20.

Wallace Patton has an abundance of gravel on the south part of section 22, but it is under 4 to 6 feet of soil and clay. F. M. Widner, Samuel Weaver and Samuel Payne have large quantities of gravel on section 28, with only two or three feet of stripping above, and so situated in the creek bluff as to be easily accessible. The gravel is generally good, with some cemented material and some fine sand. Wells and exposures in pits and bluffs show this deposit to be at least 15 to 20 feet thick, apparently resting on blue clay.

Ben De Long has gravel on the southwest quarter of section 22, and R. Baker on the northwest quarter of section 27. Ed Snyder has considerable good gravel near the center of section 25, and Harry E. Yundt has some gravel on the southeast of the southwest of section 25. In general gravel is common along the Middle branch of Wildcat Creek.

On the northeast of the southeast of 27 and the northwest of the southwest of 26 there is a large deposit of gravel on Irwin Peters' farm south of the creek and on H. Hoffman's place north of the creek. It is a good material and easily accessible. On Calvin Peters' place, southwest of the northwest of 26, there is a great bluff of boulder clay that, within 40 rods, becomes a bluff of gravel. Browning Hill, on the southeast of the southwest of section 34, is apparently the highest point in the region. It seems to be made up mainly of fine sand with some gravel. There is an abandoned gravel or sand pit in the summit of the hill. This hill is perhaps a kame or other form of glacial deposit.

Fairfield Township.

This township, including the city of Lafayette, lies west of Perry and forms the greater part of township 23 north, range 4 west. The Parker gravel pit, on the southeast quarter of section 3, is in a large deposit on the east side of Wildcat Creek, near the river. There are 30 or 40 acres of gravel of unknown thickness. There is some cemented material, some fine sand and a few boulders, but in general the gravel is of excellent quality. Hilt's pit is on the east half of the northwest quarter of section 10, on the west side of Wildcat Creek. This pit is in a deposit 10 or 12 acres in extent. The exposure shows:

		Feet.
1.	Soil and clay	2 to 4
2.	Good gravel	10

The gravel is known to extend much deeper, at least below water level in the creek. The Heilman pit, the Dave Miller pit, and others on the northeast quarter of section 10, east of Wildcat Creek, indicate abundance of gravel along this stream. It really is more widely distributed than these pits indicate, for pits are opened only in the most available places.

Frey's pit is in an extensive deposit of gravel near the center of section 21. Nothing definite is known about its thickness or extent. This deposit has furnished large quantities of gravel to Lafayette for many years, and there are at least four or five acres remaining available for the future. The following section was exposed in the pit:

Section at Frey Pit.

		Feet.
1.	Soil and yellow clay	2 to 8
2.	Gravel	1 to 2
3.	Yellow clay, about	4
4.	Cemented gravel	1 to 2
5.	Good gravel	15

There is some fine sand and a few boulders intermingled, but in general the gravel is of the best quality.

On the southwest of the southeast of section 29 there is a large deposit of gravel from which great quantities have been removed. An exposed section in Reed Beard's pit shows:

Section in Beard's Pit.

		Feet.
1.	Soil and yellow clay	2 to 4
2.	Yellow clay with pockets of gravel	2 to 3
3.	Yellow clay	2 to 3
4.	Thin layers of clay alternating with thin layers of gravel	3
5.	Blue clay with pebbles	3
6.	Yellow clay with pockets of gravel	2
7.	Fine gravel or sand exposed	15

The material is good for concrete or roads, but there is too much clay for profitable working at the present time.

On the east half of the northwest quarter of section 29 in the north bank of the creek there is a gravel or sand pit which shows the following section:

Section of Pit in North Bank of the Creek.

		Feet.
1.	Soil and clay, about	4
2.	Gravel	1
3.	Yellow clay	3
4.	Sand	1
5.	Yellow clay	3
6.	Fine gravel or sand exposed	10

On the south side of the creek there is a great bluff of clay as follows:

Section of Pit on the South Side of the Creek.

		Feet.
1.	Soil	2 to 3
2.	Yellow clay with thin layers of cemented gravel	30
3.	Coarse gravel	5
4.	Blue clay	20

On the south side of this bluff, about 40 rods away, there is an abundance of gravel. On the southwest quarter of section 29, on the south part of section 30, and on the northwest of section 31 there is an immense body of gravel. There are pits on each side of the Wabash Railway in the southwest quarter of section 29 and Stidham's pit is on the northwest quarter of 31 (23 N., 4 W.). The gravel is of excellent quality. The interstratification of clay, sand and gravel found on the southeast quarter of section 29 does not appear on sections 30 and 31 in the pits opened. The gravel runs deep, at least to low water in the river, about 60 feet.

In the 15th Annual Report of the Indiana Department of Geology, page 87, Prof. Gorby says: "The area of the great basin in the central part of Tippecanoe County is not less than 250 square miles. This ancient basin is now filled with gravel, containing a small proportion of clay, sand and boulders. The following section of the drift at Lafayette is approximately correct:

Section of Drift in the Vicinity of Lafayette.

		Feet.
1.	Soil	2
2.	Sand	10
3.	Gravel, clay and sand	70
4.	Gravel, coarse	20
5.	Gravel and boulders	20
6.	Cemented gravel	40
7.	Sandstone (cemented sand)	6
8.	Cemented gravel and boulders	15
	To surface at artesian well	183
	Section of artesian well	170
	Total	353

Other sections given by Prof. Gorby show a much larger proportion of cemented gravel than I saw, and a much less amount of blue and yellow clay. No accurate estimate can be made, but if the gravel only extends to water level, the amount about Lafayette is simply immense.

Sheffield Township.

This township lies in the eastern central portion of the county, and corresponds to township 22 north, range 3 west. The South branch of Wildcat Creek flows into the township from the east through sections 25 and 26 into 27, then turns north through the central portion of the township. Dayton, on sections 4 and 9, is the chief town of the township. Along the creek there are great bluffs of boulder clay with many small deposits of gravel, and this is generally of good quality. But the great body of gravel in the township is in the northwest portion in the vicinity of Dayton. The Dayton Mound, an esker, is the most conspicuous feature of this region. It is located mainly on sections 5, 6, 7 and 8. It is about ¾ of a mile long, ¼ of a mile wide and about 150 feet high, and is composed of sand and gravel, perhaps more sand than

gravel. The Lake Erie and Western Railway has taken immense quantities of material from this mound, and an interurban railway is now taking material from it for ballast.

To the east of the Mound on the southwest of the southeast of section 4 the railroad has an extensive pit. The deposit is at least 12 to 15 acres in extent and there are about 10 feet of gravel to water, and at least as much more below water level. In this deposit I found some rather rotten stones and some fine sand, but the railway people call it good material for their purposes.

On the northwest of the southwest of section 4 there is another pit in which there are 25 to 30 feet of gravel to water. The gravel in this pit seemed coarser than in the mound and of better quality than that in the railway pit.

From the Mound several pits were in sight, some of which were in hills that seemed to be kames or the remains of eskers. Among others are the Frends pit, on the northwest of the northwest of section 17, and Elliott's pit, on the southwest of the northeast of 18 (22 N., 3 W.). Northwest of the Mound there is a large deposit of gravel on the southwest quarter of section 6. It is covered by 2 or 3 feet of soil and has not been fully explored. On the northeast of the northeast of section 4 and the northwest of the northwest of section 3 there is a considerable deposit of gravel. In fact, sand and gravel are abundant everywhere in the northwestern part of Sheffield Township. The gravel along the creek in section 4 may be terrace formation, but it seems possible that the whole mass is of esker formation that has been spread out by the action of water.

On Catherine Baker's land, in the Richardsville Reserve, on what would be about northwest of section 22 and southwest of section 15, there is a large deposit of terrace gravel. As opened it seems good material. Gravel in the bluff on the east side of the creek from the terrace seems to rest on a bed of blue clay, while that in the terrace probably rests on the clay and is not very thick, not more than 10 to 15 feet. I saw and heard of several outcrops of gravel along the creeks that were so deeply covered with clay that they could not be worked with profit. Such deposits contribute largely to the sand and gravel found in the creek beds, which is often of very good quality.

Wea Township.

Wea corresponds to township 22 north of range 4 west. Wea Creek flows through the township northwesterly from section 35 to section 7, and Little Wea Creek drains four or five sections in the extreme southwest. There is some good gravel in the northeast.

The House pit, on the south half of the southwest quarter of section 12, and the Steckel pit, on the west half of the northwest of section 13, are in deposits that seem associated with those about Dayton. The Quaintance pit on the west half of the southeast quarter of section 17 shows the following section:

	Feet.
1. Soil and clay	1 to 3
2. Good gravel (to blue clay)	15 to 25

There are a few boulders and some fine sand, together with some cemented gravel. This pit is said to furnish excellent road material. The deposit has an extent of 40 to 50 acres.

The Richey pit, on the southwest of the northeast of section 27, furnishes some gravel, but is not much used. Elmer Waters, George Williams and others also have gravel pits along Little Wea Creek, in sections 30, 31 and 32. This gravel seems to be part of an old esker, trending toward the southwest into Randolph Township. The gravel is of good quality, making good road material.

Union Township.

This township borders the river on the north, and Wea Creek flows across its northeastern corner. There is said to be an abundance of gravel in the northern part of this township, but no pits of importance have been opened except along Wea Creek. The Wabash Railway has a large pit in the west half of section 1 (22 N., 5 W.). Jas. Vess, Will Bebee and Jas. Crow each have extensive pits in section 2. This deposit contains considerable sand and some cemented gravel, but in general it yields a good road material.

In sections 13, 23, 22 and 21 there is a range of esker-like hills of sand and gravel. There is a pit in High Gap Ridge, on the northwest quarter of section 22, and another on the northwest

of section 21 (22 N., 5 W.). The gravel is of excellent quality and of uniform size. John Griffin, on the southwest of the northwest of section 28, has several acres of good gravel. There are only about 12 feet of gravel exposed in the pit, but a driven well near by is 75 feet deep in sand and gravel. There is also an abundance of gravel on the southeast quarter of section 36 (23 N., 5 W.) and northeast of section 1 (22 N., 5 W.) in a continuation of the terrace down the river from Lafayette. A pit has been opened on the southeast quarter of section 36 by the Lafayette Gravel & Concrete Company which own 20 acres southeast of the crossing of the Monon and Wabash railways. The deposit has been tested to a depth of 65 feet. The material, as exposed in the bank, consisted mainly of uniformly coarse gravel, with very little sand. It is said to be good for concrete work.

The Monon Railway has a sand and gravel pit on the south half of section 1 and the north half of section 12 (22 N., 5 W.). This deposit of 700 to 800 acres is mainly of fine sand, a section being as follows:

Section of Monon Pit.

		Feet.
1.	Soil and clay	3 to 6
2.	Fine sand	12 to 18
3.	Rather fine gravel	8 to 12

to water in bed of creek. This section is given as an illustration of the great variety of deposits about Lafayette. The Semple gravel pit is in a little kame or conical hill cut through by the road between sections 20 and 21 (22 N., 5 W.). The hill has an area of several acres. The pit shows 8 to 10 feet of uniformly coarse gravel, apparently extending much deeper. The grains of gravel were about the size of hazel-nuts and the deposit is said to furnish good road material.

Wayne Township.

The river flows along the north and northwestern margins of this township. Flint Creek flows across the central portion into the river. The kame or esker hills of Wea and Union townships extend into Wayne Township and there is an abundance of gravel in the central portions.

Acheson's pit, on the southeast quarter of 18 and the northeast of 19 (22 N., 5 W.), is in a large esker hill. In the northeast corner of section 19 there is a gravel pit, and there is gravel along the line between sections 17 and 20. Just north of West Point, on lots 5 and 6 of Burnett's Reservation, there is a large deposit of gravel. This deposit is at least 25 or 30 acres in extent and more than 20 feet thick. The gravel is of good quality but irregular in size with considerable sand intermingled. This pit is said to furnish good road material. There is gravel in the banks of Flint Creek in lot 1 of Burnett's Reservation. Also on M. E. Sherry's place on lot 2 of the reserve.

The Sherry pit as opened shows soil and clay 1 to 5 feet and gravel 12 to 15 feet, to clay. The material is very good, but uncertain in quantity. There is also an abundance of gravel in the Semple deposit, east half of section 20, and on the east half of section 29 (22 N., 5 W.).

Lauramie Township.

This township forms the southeastern portion of Tippecanoe County. It includes township 21 north, range 3 west and the east half of range 4 west. The main streams are Lauramie Creek in the northeast and Wea Creek in the west. Gravel is not very abundant in this township.

The Martin pit, near Stockwell, is one of the best pits in the township. It is on the northwest of the southwest of section 5 (21 N., 3 W.). The deposit comprises a low hill of sand and gravel of perhaps ten acres in area. About two acres have been worked over, several miles of road having been improved from this pit. The pit shows the following section:

Section of Martin Pit.

	Feet.
1. Soil and clay with some coarse reddish gravel	1 to 3
2. Sand and gravel, exposed	12 to 15

There is some fine sand and a few boulders. The material seems to be of good quality and is said to be good road material.

Near Concord, along Wea Creek, on the southwest of the southeast of section 2, and the north half of the northeast quarter of section 11 there is a deposit of sand and gravel. It is mainly below water level in the creek. A pit about 30 feet deep has been

scooped out on the northwest of the northeast of section 11 (21 N., 4 W.). The material is rather fine and does not pack very well, but the grains are largely quartz and will doubtless wear well. There is also gravel on Grove Givins' place on the northeast of 23 and on Wm. Morin's place on the northwest of 25 (21 N., 4 W.). In each case about 8 feet of gravel is exposed, which is said to be good road material, although it has considerable fine sand and a few boulders intermingled. There are at least four or five acres of gravel on the Morin place.

The Nydegger pit, on the west half of the southwest quarter of section 19 (21 N., 3 W.), shows soil and clay 1 to 2 feet and gravel of good quality, 8 to 12 feet exposed. There are at least three or four acres of the deposit. The pit is opened in good shape and the gravel is easily accessible. Mrs. Delia Waddell has a pit on the northwest of the northwest of 11. The gravel seems of good quality, but it has not been fully tested. On Geo. W. Switzer's place, on the southwest of the southeast of section 11, a pit is being opened in water gravel. The material appears to be first-class, but it has not been well tested. The Davis pit, on the northeast of the northeast of section 31 (21 N., 3 W.), shows as follows—

		Feet.
1.	Black soil and clay	1 to 2
2.	Gravel to water	5
3.	Gravel under water	15

without reaching bottom. The material is rather fine, but it packs well and wears well. I heard several speak of it as excellent for road use. Mr. Davis thinks there are at least ten acres of the deposit, but knows nothing definite concerning its thickness.

Gravel pits on Ennis Coe's land, southwest quarter of section 21 (21 N., 3 W.), and Henry Shobe's land, southwest of 35 (21 N., 4 W.), have been abandoned, at least for the present, although the gravel has not been exhausted. No pits have been opened in the eastern portion of the towship. Lauramie Township has improved some roads with gravel from Sheffield Township.

Randolph Township.

Gravel is abundant in this township. The deposits in general seem to be in esker hills, some of considerable extent.

The Whipple pit, on the southeast quarter of section 31 (21 N.,

4 W.), is in a large deposit of sand and gravel. As opened the pit shows—

	Feet.
1. Soil and clay	1 to 2
2. Sand and gravel	10 to 12

There is considerable good coarse gravel in this deposit, but as a whole it seems rather fine for good road material and should be screened before using. It will then furnish material of good quality, which will wear well on the road. The deposit is a large one, extending into section 32, where another pit has been opened. This shows about 20 feet of gravel and is known as the Dan Simison pit. The material found in this is about the same as in the Whipple pit. The Stock Farm pit, on the southwest of 28, is another pit in the same deposit of gravel. This deposit on sections 28, 32 and 31 is thought to be an esker, extending westerly into Jackson Township.

M. F. Inskipp and G. C. Leaming each has a pit on the northeast of section 21 (21 N., 4 W.). The material is much the same as that from the Whipple pit, and probably is part of the same old esker. A well marked esker extending from the northeast toward the southwest through section 6 (21 N., 4 W.), and sections 1, 12, 11, 10 and 16 (21 N., 5 W.), contains large quantities of good gravel. Pits have been opened on sections 6, 1, 12, 11 and 10. The gravel in this deposit seems a little coarser than that on sections 28 and 32 above mentioned, and some call it better road material, but there is certainly no great difference.

Jackson Township.

There are numerous hills of sand and gravel in the southern and central portions of Jackson Township, possibly continuations of the Simison and Whipple deposit of Randolph Township. The most prominent feature in the topography of this township is the "Shawnee Mound." It is a great hill or mound of sand and gravel in the western part of the township on the northeast of the northwest of 23, southwest of the southwest of 14, southeast of the southeast of 15 and northeast of the northeast of 22 (21 N., 6 W.). It is mainly in section 22. The mound is quite symmetrical in form, rising 80 to 90 feet above the surrounding country, and has an area of 10 or 12 acres. Not only is the mound

composed of sand and gravel, but a considerable area of surrounding land is underlain with 15 to 20 feet of the same material. Over the mound there is from 1 to 6 feet of soil and clay, while from 3 to 6 feet of black soil covers the surrounding gravel. There is a large pit near the summit of the mound. As opened the pit shows more sand than gravel, but it seems to be of good quality and is said to make good roads.

There are several other pits in the vicinity, namely: The Duncan pit, on the northeast of the northeast of section 11; the Wray pit, on the northwest of the northwest of 6; the A. Wallace pit, on the southwest of the southeast of 24, and the Abe Meharry pit, on the southeast of 3 (21 N., 6 W.); also the B. Simison pit, on the west half of the northeast quarter of section 20; the W. Boland pit, on the northwest of the southwest of 28, and the James Stewart pit, on the north half of the northeast quarter of section 30 (21 N., 5 W.). The material in these different pits seems to be of good quality, but in general, unless screened, there is too much sand for first-class road use. The fine material is quartz sand and it wears well, so that the "bank run gravel" makes a fairly good road material.

WARREN COUNTY.

Area in square miles	366
Population in 1900	11,371
Miles of public roads	610
Miles of improved roads	186
Percentage of roads improved	30.5
Miles improved with gravel	186
Miles improved with crushed stone	None
Average original cost of gravel roads per mile	$2,100
Total original cost of improved roads	$390,600
Annual cost of repairs per mile on gravel roads 5 years old	$100
Miles of improved road (gravel) built in 1905	32
First improved roads built	1884
Proportion of improved roads built since 1895 (per cent.)	45
Satisfaction of farmers with investment in improved roads—	"Most generally are well satisfied"

Authorities—

R. L. Winks.....County Auditor
W. H. Gemmer.....County Surveyor

Warren County lies on the western border of the State, and is bounded on the north by Benton County, on the west by Illinois and a small part of Vermillion County, on the south by Vermillion County, on the southeast by the Wabash River and on the east by Tippecanoe County. It is divided into eleven townships—Medina, J. Q. Adams, Pine and Prairie on the north, in township 23 north; Warren, bordering the river; Liberty and Jordan, in township 22 north; Washington, Pike and Steuben, in township 21 north; Kent and Mound, extending from the river to Illinois, in township 20 north.

The county is drained by several small streams flowing into the Wabash. In the east Little Pine Creek drains Medina and the east part of Warren Township. Kickapoo drains Adams and the western part of Warren, while Pine Creek drains Pine Township, part of Adams, and Liberty Township. Rock Creek, between Washington and Pike Townships; Redwood, between Pike and Steuben; Possum Run, in Steuben, and Spring Creek, in Mound Township, are the principal streams. Prairie and Jordan Townships are drained by Jordan Creek, a tributary of the Vermillion River in Illinois.

There is a narrow flood plain along the Wabash River, then a terrace, or second bottom of sand and gravel, then the uplands. The uplands fronting toward the river are somewhat broken, and there is considerable broken country along Pine Creek in Liberty Township, but in general the northern and western parts of the county are rolling prairie lands.

The shales and sandstones of the Coal Measures outcrop along the streams on the river side of the upland, but in general they are deeply covered with drift, perhaps as much as 100 feet in thickness. The county in the north and west has an elevation of about 700 feet, rising about 200 feet above low water in the river. Rock is common in the bluffs and sometimes in the bed of the river from the east line of the county, southwesterly five or six miles to Independence. Below Independence the bed of the river seems to be of sand and gravel.

Medina Township.

Medina Township has but little gravel and but few miles of gravel road. The roads were improved with gravel from the banks or bed of Little Pine Creek, from small local pits and from "Indian Hill," in Tippecanoe County. On the northwest quarter of section 28 (23 N., 6 W.), near Green Hill, Jacob Mann has a small pit. The gravel is from 7 to 10 feet thick and of good quality, but it is covered with from 8 to 12 feet of soil and clay, so that it can not be profitably worked except along the outcrop. Gravel is reported on the northeast quarter of section 28, but it has not been developed, and nothing is known of its extent or depth. W. E. Cooper has three or four acres of gravel on the northwest quarter of section 32 (23 N., 6 W.). It is 12 to 18 feet deep and is said to make a good road. It has not been very well developed. There is also some gravel on the northwest quarter of section 17, but it contains a great deal of sand and soil, so that it is not considered of good quality.

Johnson's gravel pit and Harvey and Franklin's pit, on the southwest quarter of section 29, show 8 to 10 feet of gravel to water, but the stripping is heavy and the gravel can not be worked with profit. It is called good road material. The area of the deposit is quite extensive, but not definitely known, and is deeper than the deepest wells. Roads in this township are being improved with imported gravel.

Adams Township.

There are a few small gravel pits in Adams Township, but none of importance. Some roads have been improved with material from local pits, but repairs are made with gravel shipped from Kickapoo, in Warren Township, or from Indian Hill, in Tippecanoe County.

Pine Township.

Some roads in Pine Township have been improved with gravel from local pits. Will Hurst, George Hillyerd, Frank Brian, Lillie A. Gray and others in the neighborhood of Rainsville, sections 20, 21, 22, 23, etc. (23 N., 8 W.), have furnished gravel

for roads, but repairs are generally made with material from Kickapoo, in Warren Township.

Prairie Township.

There is no bank gravel in Prairie Township that could be called workable. Some roads have been improved from local pits, but these seem exhausted, so that the repairs in general are made with gravel from Kickapoo.

There are some deposits of water gravel, but they have not been well explored and little is known of their extent or quality. They are pumping gravel from a pit on section 30 (23 N., 9 W.), but it is not of a very good quality. There is some gravel in section 12 (23 N., 10 W.), in the northwest part of the township, but it does not seem to be of special value. There is an old pit on the Vennum land, northwest quarter of the southeast quarter of section 36 (23 N., 9 W.). It is in the top of a hill some 40 feet high. The deposit is perhaps six or seven acres in extent and some 15 to 18 feet of good gravel is exposed in the pit, also some sand and a few boulders.

Gravel is reported on Harrison Goodwin's land, on the northeast quarter of section 30, and on John Carlson's land, northwest quarter of section 21 (23 N., 9 W.). Other deposits were mentioned, but none were well developed and none appeared to be of much importance.

Warren Township.

On the southeast quarter of the southeast quarter of section 5 (22 N., 6 W.), there is an acre or so of good but rather fine gravel, perhaps 10 feet deep. It is covered with only a foot or two of soil, is easily accessible, and is said to make a good road. This gravel is part of a ridge extending about a quarter of a mile eastward into section 4. The ridge seems to be made up largely of sand, with some gravel. A little pit on the southwest of the southwest of section 4 shows a fine quality of coarse sand, highly prized for concrete work. There is some gravel on the northeast of the northwest of section 4 on Wm. Young's land, and on the northeast quarter of the same section is the Francis pit.

In the bank of Little Pine Creek, on the southeast quarter of

section 5, on the Banning land, there is an extensive deposit of gravel or of sand and gravel, mixed with considerable soil. In making an approach to a bridge a deep cut was made through this deposit and some three or four miles of road were improved with material taken out, but it is not called good road material. The deposit is perhaps ten acres in extent and 20 feet deep, with but little stripping. The road made from this pit seemed fairly good, but appears to be wearing out rapidly. On the southeast of the southeast of section 7, Clarence Dawson has two or three acres of good gravel, but it is covered with six or seven feet of soil, so that it can hardly be worked with profit. There are several other small banks of gravel along Little Pine Creek, but none of importance.

On the northeast of the northeast of section 23 (22 N., 7 W.), near Independence, there are two hills of gravel about an acre each in extent, owned by Jade Steadman. The gravel is from 1 to 16 feet thick and makes a good road. The Independence and Clawson road, about four miles in length, was made from this deposit.

There is a gravel pit on the northeast quarter of the southeast quarter of section 29 (22 N., 7 W.), which has yielded large quantities of gravel. The material is of good quality, with some fine sand and a few boulders mixed through it. Nothing definite is known as to the depth or area of this deposit. There are at least from 80 to 100 acres of gravel from 75 to 100 feet thick. It is part of the bank of the valley of Kickapoo Creek, where it opens into the valley of the Wabash.

Northeast of this deposit up the valley in section 21 (22 N., 7 W.), a well shows soil three feet and gravel 73 feet. On section 22, on Mr. King's land, the gravel in a well of about the same depth was separated into distinct beds or layers by strata of clay. Mr. H. L. Winks, a well digger, says that there are at least two sections, or 1,280 acres, of land underlain with thick beds of gravel, as shown by wells which he has dug or which he has known personally.

On the west side of Kickapoo Creek on the east half of section 30, the west half of section 29 and the east half of section 20, there is an abundance of good gravel. The Chicago & East-

ern Illinois Railway runs over this land, and the railway people have opened a large pit in sections 20 and 29. William Douglass has a pit on section 29, and Mrs. Lindsey has some 20 acres of gravel on the southeast of section 20. H. L. McKenzie has 40 to 50 acres of gravel in the south half of section 20, and Robert Milligan has considerable gravel in the southeast of 30 and the northeast of 31 (22 N., 7 W.). This gravel is of good quality, but contains considerable sand and a few boulders. Near the surface there are many large masses of cemented gravel. The railway people break these up and use the material for riprapping, etc. This cemented portion does not extend very far back into the deposit. Nothing is known as to the depth of the deposit.

Malady's gravel pit, on the southwest quarter of section 17 (22 N., 7 W.), is in a large deposit of sand and gravel from 15 to 20 feet thick. In it there are many small boulders. The deposit is covered by from 2 to 4 feet of soil and clay. T. A. Barns has a pit on the northeast quarter of section 16, but it is not very large. The gravel is abundant in section 20 and in the south part of 16, and runs deeper than the deepest wells. On the west half of the southeast quarter of section 2 (22 N., 7 W.), Henry Brutus has a well showing—

	Feet.
1. Soil and clay	80
2. Fine sand	118

to water and sand. No bed rock at 198 feet.

Liberty Township.

Pine Creek runs through this township and much of its area is broken. In general the bluffs are of boulder clay, sometimes of rock, but occasionally there are deposits of gravel. On the northeast of the northeast of section 22 (22 N., 8 W.), J. P. Bennett has a gravel pit. J. P. Hunter has one on the southeast of the northwest of section 23; H. L. Kramer one on the southwest quarter of section 23; William Johnson one near the center of section 22, and Charles Dick one on the southeast of the northwest of section 22. Newton McClure has four or five acres of gravel on the northwest of the northeast of section 27. There are doubtless other deposits, but the ones mentioned furnish most of the

road material used in the township. These deposits are often deeply covered with boulder clay, so that little is known of their extent. In some cases there are 30 to 50 feet of gravel down to the level of the creek bed. Mr. Johnson thinks he has about 25 acres of gravel at least 50 feet thick. The gravel is of good quality, but contains some fine sand and a few boulders. It is called good road material, as it wears well.

Several pockets of gravel occur on Sam Creamer's place, on the southeast quarter of section 9 (22 N., 8 W.). Some are good and some not very good. None of them are well developed. William Bottorff, on the northwest of the northwest of 7 (22 N., 8 W.), has a hill with 12 to 15 feet of gravel to water. The deposit extends onto adjacent land, covering an area of five or six acres. It extends at least ten feet below water level. Part of that above water level is rather dirty, but is called good road material. There is a small deposit on the northwest of the southwest of section 6 called good gravel, but it has not as yet been developed.

Jordan Township.

No bank gravel was found in this township, but several deposits of water gravel are known to occur. William Sibbits has a pit on the southeast quarter of the northeast quarter of section 12 (22 N., 10 W.), which shows soil and clay 2 to 3 feet and fine gravel or sand 2 to 13 feet. Similar material occurs on the northwest quarter of the northeast quarter of section 12. Not much is known about the area of these deposits, but Mr. Sibbits thinks he has at least 10 acres of workable gravel in the southeast of the northeast of section 12. The material is very fine, really sand, but, contrary to expectation, makes a very good road material, and would make a better if it were screened. At first Mr. Sibbits pumped water and shoveled gravel, but soon thought it more profitable to pump the gravel.

On the northeast quarter of section 17, on the northwest quarter of section 16, and on sections 8 and 9, all in township 22, range 9 west, there is an extensive deposit of water gravel. A pit has been opened on the northeast of the northeast of section 17 (22 N., 9 W.), on the land of Harry Pense. Soil about 3 feet covers gravel 10 to 14 feet. It is of excellent quality and makes

good concrete, but it is rather fine for ideal road material. Not much is known about the extent of the deposit, but it underlies at least 1,000 acres. This deposit was opened in the season of 1905. There is also good gravel on the south half of section 32 (22 N., 9 W.).

The wells in this township show considerable deep gravel. One in the north half of section 31 (22 N., 9 W.), shows 85 feet of soil and clay and 25 feet of gravel. Another in the same neighborhood shows 72 feet of soil and clay and 9 feet of gravel. A third on the Hedrick land, southeast quarter of section 36 (22 N., 10 W.), shows 80 feet of soil and clay and 25 feet of gravel, while a fourth on the John Crawford farm, northwest of northwest of 36, shows 75 feet soil and clay and 25 feet of gravel.

On the northeast quarter of section 10 and the northwest quarter of section 11 (22 N., 9 W.), the wells show clay and soil of varying depths, 5 to 25 feet, then gravel from 30 to 50 feet, over an area estimated at 200 acres.

Washington Township.

This township borders on the river and has considerable gravel on or in the second bottom. There is an abundance of gravel on both sides of the railway in sections 10 and 11 (21 N., 8 W.). The gravel in this deposit runs deep and is of good quality. There is also a plentiful supply on the east half of section 29 and the west half of section 28 (21 N., 8 W.), on the lands of D. B. Crane, Wilmer Schaefer and George Bowlus. No extensive pits have been opened in the south part of this township, but pits in the same deposit a little farther west show the gravel to be of good quality. Wells show this gravel on sections 28 and 29 to be more than 90 feet thick. It may not be as good as that along Kickapoo Creek, but it is called good road material. There is doubtless considerable gravel between sections 10 and 28 in this township. but none has been developed.

Pike Township.

Pike Township borders on the river and has some terrace gravel. William Brennan has a pit on the northeast quarter of the southwest quarter of section 29; T. H. Crane one on the southwest quar-

ter of the northeast quarter of section 30; Mrs. Warrenfield one on the southeast of the northwest of section 30, and Geo. W. Beggs one on the northwest of the southwest of 31 (21 N., 8 W.). All are on the terrace, each showing good gravel. There is some gravel along the streams, but the pits mentioned are the only ones of importance in Pike Township.

Steuben Township.

Not very much gravel occurs in Steuben Township. There is a pit on the Van Leers place, near the creek, in the east half of the northeast quarter of section 22 (21 N., 9 W.), showing soil and sand 5 to 7 feet, and gravel 12 to 18 feet. The gravel is dirty, contains many flat pebbles and bits of shale and some rotten stones. The road running east and west about one mile north of Marshfield was improved with material from this pit. It makes a fairly good road for light travel.

Some gravel is taken from the creek bed on Bent Reynolds's place on the east half of the northwest quarter of section 26 (21 N., 9 W.). The road through Marshfield was made from gravel taken from the Reynolds pit, on the William Smith land in the eastern part of Steuben Township. Some gravel has also been taken from the Starry pit on the southwest quarter of section 18 (21 N., 9 W.), but it is not very good road material.

Kent Township.

The second bottom is narrow in this township, and gravel is not common. Several pockets of gravel of small size occur along the bluffs, but no pits of importance have been opened.

Mound Township.

There is an abundance of good gravel in the southeast portion of Mound Township. On the Dave Talbot place in the north part of section 28 (20 N., 9 W.), and on the Richey place, in the southeast of 28, there are quantities of good gravel. The Big Four Railway has extensive gravel pits on the southwest quarter of section 27. Some of this gravel is very fine quality. There must be more than 100 acres of good gravel in sections 27 and 28.

There are no other pits of importance in the township, but there is doubtless plenty of gravel in sections 33 and 34 (20 N., 9 W.). In Kent and Steuben townships the bluffs toward the river are generally of boulder clay, with pockets of gravel, and there is considerable terrace gravel. There is but little gravel in the western part of Kent and Mound townships. Much of that in sections 27 and 28 probably extends below water level.

FOUNTAIN COUNTY.

Area in square miles	383
Population in 1900	21,446
Miles of public roads	1,200
Miles of improved roads	502
Percentage of roads improved	41.8
Miles improved with gravel	500
Miles improved with crushed stone	2
Average original cost of gravel roads per mile	$2,000
Average original cost of stone roads per mile	$2,500
Total original cost of improved roads	$1,005,000
Annual cost of repairs per mile on gravel roads 5 years old	$100
Annual cost of repairs per mile on stone roads 5 years old	$100
Miles of improved roads (gravel) built in 1905	50
First improved roads built	1883
Proportion of improved roads built since 1895 (per cent.)	40
Satisfaction of farmers with investment in improved roads*	Good
Authority	Jas. T. Bell, County Auditor

*A very large per cent. of the farmers would prefer having the roads placed back on the townships, as they could be taken care of better and cheaper.—J. T. B.

Fountain County borders on the Wabash River, which separates it from Warren County on the northwest and from Vermillion County on the west. Parke County is on the south and Montgomery and Tippecanoe bound it on the east. The principal streams are Big and Little Shawnee Creeks in the north; Coal Creek and its tributaries draining the central portion, while the Mill Creeks drain the southern part of the county. Low water in the Wabash at Attica is about 500 feet above tide, while at Covington it is 491 feet. Hillsboro, in the eastern part of the county, has an elevation of 728 feet, and hills about Attica have about the same elevation.

The surface is rugged along the larger streams, but in general it is a gently undulating plain, sloping toward the river. There

are great quantities of sand and gravel in the terrace along the river. In the northern portion of the county there are a number of hills, made up largely of sand and gravel. These hills may be kames or remains of eskers, and in formation were doubtless associated with similar hills found in Tippecanoe County. These hills contain large quantities of gravel. Along the larger streams there are many deposits of gravel, put down in glacial times perhaps, but opened up by the erosive work of the streams. In the larger streams there are frequently deposits of good gravel put down by the present streams from subsiding floods.

In general the county is well supplied with gravel of a good quality. On section 28 (18 N., 8 W.), there is an outcrop of hard limestone in the banks of Wabash Mill Creek that would doubtless make good road material, and on section 16 (22 N., 6 W.), there is a large bed of flint rock that makes an excellent road material.

Davis Township.

This township is in the northeastern portion of the county, bordering on the river. It extends northerly about seven miles from the middle of township 21 north. The river bluff is largely of boulder clay, although sandstone strata outcrop in many places.

The Flint bar, on the bank of the river in the southwest of 16 (22 N., 6 W.), has an area of about 100 acres. The upper three or four feet consists of flint rock that has been broken in fragments ranging from three inches downward. Then there are three or four feet of unbroken rock to shale. This broken rock has been used extensively in making streets in Lafayette and in making roads. For many years the material was used as found in the bar, but a few years ago the Western Construction Company installed an extensive plant and began crushing the stone, screening it into desired sizes and washing it, thus putting it into much better form for use. For some time a large business was done, but for some reason the work has been abandoned, at least temporarily.

The flint is sometimes used as a foundation and covered with sand or fine gravel as a binder. In other cases somewhat finely pulverized flint it is used as a binder or top dressing. G. H. Steven-

son, engineer, says the flint wears better than limestone, is not so dusty, and that the dust formed is not so irritating as the lime dust. Mr. Stevenson said the flint was especially used for improving the steep grades so common in Lafayette. The bar is flooded by very high water. I could get no idea of the extent of the flint rock, but heard of outcrops about three miles south of West Point, in Tippecanoe County. Samples of the flint were tested in the laboratory of the U. S. Department of Agriculture at Washington, with the following results:

*Results of Physical Tests of Flint from near Attica, Fountain County.**

Specific gravity	2.5	French coefficient of wear.	13.5
Weight per cu. ft. (lbs.)	152.8	Cementing value—Dry	2
Water absorbed per cu. ft. (lbs.)	2.83	Wet	15
Per cent. of wear	3		

"Good resistance to wear and fair cementing value. Not sufficient material for hardness and toughness tests."—Page.

An analysis of the flint was made at the same laboratory, with the following results:

Analysis of Samples of Flint from near Attica, Fountain County.

	Per cent.
Alumina (AlO)	1.00
Iron oxide (FeO)	.25
Lime (CaO)	2.25
Magnesia (MgO)	.80
Insoluble in hydrochloric acid	91.47
Loss by ignition	4.39
Total	100.16

This flint rock has been used for street improvement in Lafayette on Perrin Avenue and on Ninth Street; on the Sixth Street hill, on Fourth Street and on Heath Street, between Sixth and Ninth.

Along the bluff there are occasional deposits of sand and gravel. On the southeast quarter of section 16 there is an abundance of sand, but no gravel. It seems possible that there might be some gravel in this deposit.

On the southwest of section 30 (22 N., 6 W.), there is a large

*See page 79.

deposit of gravel, in which the Funk pit has been opened. The exposure shows—

	Feet.
1. Soil and clay	1 to 2
2. Gravel	8 to 10

In this deposit there is considerable fine sand and a few boulders. In it I found many rotten granite and ironstone pebbles, so that it could hardly be called first-class road material. The roads made of it are smooth and hard, and seemingly wear well under ordinary traffic. The deposit is thought to be at least 20 to 25 feet thick, and to have an extent of six to eight acres.

The Thompson pit is on the northwest quarter of section 25 (22 N., 7 W.). There is here a small deposit of gravel which contains considerable sand and some clay. As opened there are only five or six feet of gravel, which is not much used.

Thompson's pit, on the southwest of the southwest of 36 (22 N., 7 W.), is in quite a large deposit of fairly good gravel. It extends into section 1 (21 N., 7 W.), and into the adjoining sections on the west. No gravel has been taken from this deposit for several years. The road on the line between section 36 (22 N., 7 W.), and 1 (21 N., 7 W.), cuts through a hill that shows some gravel toward the top. On the northeast of the northeast of 1 about 15 feet of gravel is exposed in the Morgan and Britt pits. The area is probably not more than two acres. There are perhaps three or four acres in section 36, across the road. It does not seem to be very good gravel, but is said to make a fairly good road. There is a gravel and sand hill or ridge on the south part of the northwest quarter of section 1 (21 N., 7 W.), which may be a kame or part of an old esker, but no pit has been opened in it. There are other deposits of gravel reported in the southern part of the township, but there are none of much importance. The E. B. Hughes pit on the southeast of 4 (21 N., 6 W.), and the Waldrip pit on the southeast of the northeast of 12 (21 N., 6 W.), have furnished some road material.

Logan Township.

This township borders on the river and lies west of Davis Township. The bluff in the north is largely of boulder clay, with many boulders and a few small pockets of gravel. Sandstone out-

crops at several places along the bluffs. Great quantities have been quarried on section 26 (22 N., 7 W.). Much of this is hard sandstone and might make good material for the foundation of a road. The city of Attica stands on a great mass of gravel. The wells show gravel 95 feet below low water mark, while the reservoir on a gravel hill is 215 feet above low water. The city reservoir and Arms gravel pit are on the southwest of the southwest of 5 (21 N., 7 W.). On the northwest of section 5 there is considerable gravel, but not very thick, only 20 to 30 feet to rock. On the southwest and northwest of 7 and on the west half of 8 gravel is abundant. Pits opened show soil and clay 1 to 6 feet, sand and gravel to bed rock, 40 to 50 feet. An eight-acre swamp or swale, on the southeast of the northwest of 8, shows—

	Feet.
1. Muck	1 to 2
2. Clay	5 to 16
3. Sand and gravel	30 to 40

Young's pit, on the northwest of the southwest of 7, is in the edge of the terrace, where a face of 30 feet of gravel is shown. The area is not known, but it must be extensive. The gravel is of fine quality, but it contains a great many small boulders.

The Wabash Railway has opened a great sand and gravel pit along the terrace in sections 12 and 13 (21 N., 8 W.). There are about 80 feet of gravel exposed in the pit. The material from this pit is called good for road making, for cement work and for plastering. Looking eastward from the reservoir at Attica, one may see several conical-shaped hills, which, on investigation, appear to be kames or eskers, and generally contain gravel.

The Slusser gravel pit, on the northwest of 3, and the Leasure pit, on the northeast of 3 (21 N., 7 W.), are in kame-like hills, and there is an esker hill of gravel and sand on the northeast quarter of section 2 (21 N., 6 W.), on which stands a school house, church and cemetery. There is a gravel pit on Mrs. Huddle's land in the bank of Nave Creek, in the southeast of the southeast of 14 (21 N., 8 W.), which exposes an abundance of gravel of good quality. Along the road south, between sections 7 and 8, 17 and 18 (21 N., 7 W.), the telephone poles are frequently set in the gravel.

Shawnee Township.

This township has a river front of about four miles. There is considerable gravel along the terrace in sections 22, 23 and 27 (21 N., 8 W.), but it is not as abundant as it is farther north. There is also gravel along the Big Shawnee Creek in section 23, but I saw no gravel pits.

The Orland pit, on the southeast of the northeast of 27 (21 N., 8 W.), appears to be in a large deposit. The pit shows soil and clay 2 to 3 feet and gravel 10 to 12 feet to level of water in the branch. There is some fine sand and many boulders, but there is a large proportion of coarse gravel of good quality. It is called good road material. There is an abundance of good gravel along the Big Shawnee in section 24 (21 N., 8 W.), and on section 19 (21 N., 7 W.). The gravel is of good quality, but the deposit is not very thick, not more than 10 or 12 feet. John L. Foster has a large area of sand and gravel in section 30 (21 N., 7 W.). The deposit yields an excellent material for cement and plaster, but is rather fine for road material. The Galloway pit on the southwest of section 11 (20 N., 8 W.), furnishes some fairly good gravel. In the southeastern part of the township considerable gravel from the bed of Coal Creek is used for road material. Gravel of very good quality is found on the northwest quarter of 8 and the northeast of 7 (20 N., 7 W.). Some consider this stream gravel as good or better than bank gravel.

There is some gravel along the Shawnee creeks in the eastern part of the township, but no good pits have been opened. In general the pits in Shawnee Township yield more sand than gravel, but the material is of good quality and wears well. Some gravel occurs along Bear Creek, on the southeast of section 32 (21 N., 8 W.), but no pits were seen. Along Bear Creek there is an abundance of good sandstone. There is a good supply of gravel on the Evans Claypool place on section 21 (21 N., 7 W.), along the Big Shawnee.

Troy Township.

This township has a river front of about twelve miles. Covington, the county seat, is the chief town, and is situated on the bank of the river. There is an abundance of gravel in the terrace in the northwestern part of the township.

On George Hunt's place, in the northwest of section 5, there is a great body of good gravel, and there is also a deposit of similar material on the southeast of section 6 (20 N., 8 W.). A large part of sections 12, 14 and 23 (20 N., 9 W.), and parts of adjoining sections consist of sand and gravel from 75 to 140 feet thick to water level in the river. A pit has been opened on the northeast of the southwest of 12, on R. S. Nebeker's land. The gravel is of excellent quality, but rather fine for good road material. John Bilsland also has a pit on the northwest of 24 and another on the north half of the southeast quarter of section 22, while E. H. Nebeker has a third on the east half of the southwest quarter of section 24 (20 N., 9 W.). The supply of good gravel in this region seems to be unlimited.

The McCabe pit, on the northwest of the northeast of 36 (20 N., 9 W.), furnishes great quantities of good gravel. It is in the suburbs of Covington, and is said to yield better material than any other pit in the township. The DeHaven gravel pit is on the east half of the southeast quarter of 30 (20 N., 8 W.). This pit yields large quantities of medium quality gravel. The Anderson pit on the southwest of the southwest of 12 (19 N., 9 W.), furnishes also an abundance of gravel, but rather fine for first-class road material. John Tamberlane and others in this region have good gravel. Troy Township gets some gravel from the Galloway pit in Shawnee Township and some from the Hepler pit in Van Buren Township. There is not much gravel in the southeastern portion of the township.

Wabash Township.

The bluff along the river in this township is largely of boulder clay. The pockets of gravel are few and small.

There is quite a large deposit of sand and gravel in the lands of E. R. Marlatte and others, mainly on the northwest quarter of 29, and the southwest of 20 (19 N., 8 W.). On the Marlatte land, on section 29, is the Buckhorn pit. It is on the bank of a branch of Coal Creek. There are perhaps 20 acres in this deposit. The pit as opened shows: Soil and clay, 1 to 3 feet, and gravel, 10 to 12 feet. Another pit in the same deposit shows about the same material. There is some sand and a few boulders, but the material is of good quality and makes a fairly good road.

Mr. Wells, on section 20, has an abundance of gravel, much like that on 29. It is called good road material. This deposit, something like a terrace along the creek, is the chief source of bank gravel for Wabash Township. Considerable gravel is taken from the bars of Coal Creek for road purposes. A good quality is found near Snoddy's Mills, on the southeast of section 1 (18 N., 9 W.), but it does not pack very well and is not considered first-class road material. Wabash Township also gets some gravel from the Ratcliff pit, in Fulton Township, and some from the Patton pit, in Van Buren Township.

Fulton Township.

This township forms the southwestern portion of Fountain County. It borders on the river for about five miles. Coal Creek flows southerly across the township just west of its center, and Wabash Mill Creek flows across the southeastern part of its area. These streams and the river give Fulton Township considerable broken surface. Sand and gravel are quite abundant.

The Richardson pit is on the southeast of the southwest of section 7 (18 N., 8 W.), in a deposit of four or five acres of gravel. As opened the pit shows soil and clay 1 to 3 feet and gravel 12 to 15 feet. It is called good road material. On the northwest of the northwest of section 7 there is a large deposit of sand good for plaster and cement. About the corners of sections 7, 8, 17 and 18 there is a deposit of gravel in which several pits have been opened by Elwell, Getts & Hardesty. This deposit yields fairly good road material. Samuel Cates's pit on the southeast of section 9 (18 N., 8 W.), furnishes material that contains too much sand.

The following pits in this region all supply a good road material: The Burnside pit, on the southeast of section 13; the Charles Guy pit, on the southwest of 24; the McLean pit, on the southeast of 36; the E. M. Waterman pit, on the southwest of 35; the Samuels pit, on the southwest of 23; the Ratcliff pit, on the southeast of the southwest of 10, and the J. Hathaway pit, on the northwest of 23 (18 N., 9 W.).

The Clover Leaf Railway has a large pit on the east half of section 34 (18 N., 9 W.). They have worked over 15 to 20 acres of gravel. As shown in the pit, there is—

Section of Clover Leaf Pit.

		Feet.
1.	Soil	1 to 3
2.	Sand and gravel	18 to 20
3.	Boulder clay and boulders	12
4.	Bed rock	.....

In the edge of the terrace near the river there is another deposit of gravel at least 40 feet thick and several acres in extent. The deposits seem much alike, are both of excellent quality and are near one another, but the railroad gravel is above that by the river. The railway pit is on a rock, the south end of Silver Island. The island is three or four miles long from north to south and about one mile wide. Several gravel pits have been opened in the deposits along this ridge. In the railway pit there are a few boulders and considerable sand. In one region of the pit a great many clay boulders are found. They are composed of different kinds of varieties of boulder clay, and reach a size of two and a half to three feet.

The George Towell pit, on the northeast of 28 (18 N., 8 W.), near the falls of Wabash Mill Creek, shows 2 to 3 feet of soil and clay and 10 to 12 feet of good gravel to water. The gravel extends considerably below the level of the rock at the falls, and may be in an ancient channel. About three acres have been worked over and there is as much more available. Quite as much gravel goes from this pit into Mill Creek Township as is used in Fulton Township.

The falls in Wabash Mill Creek are caused by a stratum of hard, blue limestone, seven to nine feet thick, that rests on a bed of shale. It might make good road material and is more promising than any other I saw in the county. A large area could be worked without the expense of stripping.

Mill Creek Township.

The surface of the township is quite uniform, there being no large streams and but little broken ground. The supply of gravel is rather scanty.

M. Little's pit, on the northwest of 27 (18 N., 8 W.), contains two or three acres of gravel perhaps 10 feet thick. It is of fairly good quality and many think it is the best in the township.

The Reath pit, on the southwest of 32 (19 N., 7 W.), near Steam Corner, has been sunk about 15 feet to water. The gravel below water level is of good quality, but the depth is not known. Some gravel from the bed of Mill Creek is used in repairing roads. The township gets gravel from Fulton, Van Buren and Jackson Townships.

Limestone from a quarry near Yeddo, on the southwest quarter of section 7 (18 N., 7 W.), has been used to some extent for improving roads. The rock is hard, but it splits into flakes, thin and wide, not a very good form for road material. The mile or so of road improved with it is not ideal, but it does not seem to have been well made, so that the material has not had a good chance to show its fitness.

Van Buren Township.

Veedersburg is the chief town of the township, and Coal Creek, with its valley, are the dominant features in the topography. In the banks and bed of the creek there are sandstones, shales and coal. There is also an abundance of boulder clay, with large quantities of sand and gravel.

Near Stone Bluff, John M. Meeker has a gravel pit on the northwest of the northwest of 19, and two on the southeast of 18 (20 N., 7 W.). Apparently the gravel is abundant, but nothing very definite is known as to its extent or depth. It only makes a medium quality of road material. Stream gravel, mainly from Coal Creek, is used to some extent in this township. On section 12 (19 N., 8 W.), southwest of Veedersburg, there is a great mass of gravel in the edge of the terrace or bluff. James Songer and Richard Hatfield have pits in this deposit. The pits show 1 to 2 feet of soil and clay and 15 to 20 of gravel exposed. There are some boulders and considerable sand, but in general the material is very good for road building. There are probably 50 or 60 acres in the deposit, and it may go deep below water level. There is gravel on the southwest quarter of the section, and also at places along the railway between Stone Bluff and Veedersburg.

Volney Patton, on section 24 (19 N., 8 W.), and William Dice, on the west half of section 19 (19 N., 7 W.), each have an abundance of good gravel. In general it is abundant along Coal Creek.

Richland Township.

This township extends through township 20 and three sections into 21 north, and is in ranges 6 and 7 west. It is drained by the branches of Big Shawnee and Coal creeks, but the valleys are not deep and the surface is quite uniform. Considerable of the gravel used for road purposes is taken from the beds of the streams. Sand and gravel are widely distributed, but there is very little first-class road material in the township.

John Neal, on section 26 (20 N., 7 W.), has a large deposit of gravel, 10 to 12 feet thick, but it is rather fine for road material. Several miles of road have been improved from this deposit, and there are several acres left for future use.

Will Gallagher's pit on section 19 (20 N., 6 W.), shows much the same material as is found in the Neal pit, but it is considerably thicker as opened. Sand of good quality for plastering or cement work is abundant in this deposit. The Broderick pit, on section 21, is in a deposit of two or three acres of medium material, about 12 feet thick. The Keyte pit, on section 17, and the Coon pit, on section 7 (20 N., 6 W.); the Parnell pit, on section 19, and the Dodge pit, on 21 (21 N., 6 W.), all furnish material of a medium quality. The Bookwalter pit, on section 2 (20 N., 7 W.), is in a deposit of several acres of what is called good road material. The soil and clay are from 4 to 6 feet thick above 8 feet of gravel. It can not be worked with much profit.

Cain Township.

This township is drained by a branch of Coal Creek. Hillsboro is the chief town. There is considerable sand and gravel in the township, but it makes only fair road material.

Jake Hesleve, on the southwest quarter of section 27 (19 N., 7 W.), has four or five acres of fairly good road material, and Joe Glascock, on the southwest of 10, has several acres of sand and gravel, but the sand predominates, so that the deposit does not yield first-class road material. It is, however, about as good as the township affords.

Joel Tinsley, on the southwest quarter of section 7 (19 N., 6 W.), has an abundance of sand and gravel, but as a whole it is too fine for first-class road material. The sand is said to be good

for concrete work. The bank run material makes a fairly good road—one that beats a clay road out of sight. Jesse Brant, on the southeast quarter of section 8, and Charles Armentrout, on the northeast of 21 (19 N., 6 W.), each has several acres of sand and gravel. The sand is of good quality and there is some good gravel, which could be had by screening. H. S. Edwards, on the southwest quarter of section 5, has 5 or 6 feet of gravel to water, but little is known of how much there may be below water level. The material is of good quality. Gravel from the streams is used extensively for road building in this township, and is called good.

Jackson Township.

This township comprises township 18 north, ranges 6 and 7 west. Sugar Mill Creek flows southwesterly across its area. The suface is somewhat broken along the creek, but in general is undulating. Wallace, just south of the center, is the chief town. Good road material is not common.

Jonathan Cunningham, on the southeast quarter of section 26 (18 N., 7 W.), has an abundance of sand and gravel. The material is of good quality, but too fine for first-class road material. This deposit contains the best material in the neighborhood and supplies large quantities to the southwestern portion of the township, sending some into Parke County.

The Carter gravel pit, on the southeast quarter of section 13, is a large, shallow pit, with about 8 feet of medium road material. There are perhaps six acres in the deposit. It makes fairly good roads, but does not wear very well. Columbus Young, on section 12, has several acres of sand and gravel. Some portions of this deposit yield very good road material.

Jacob Bowman, on the southwest of 17 (18 N., 6 W.), has an abundance of good gravel, but it is under 4 to 6 feet of soil and clay, so that it is difficult to work. Much of the road from Wallace north to Hillsboro was built from the J. B. West bank, on the northwest of the northwest of section 6 (18 N., 6 W.), but this bank has not been in use for several years. There are some deposits of gravel about Wallace and at other places in the township, but none of much importance have been opened. Jackson Township uses considerable stream gravel.

MONTGOMERY COUNTY.

Area in square miles	508
Population in 1900	29,388
Miles of public roads	827
Miles of improved roads	450
Percentage of roads improved	54.4
Miles improved with gravel	450
Miles improved with crushed stone	None
Average original cost of gravel roads per mile	$1,500
Total original cost of improved roads	$675,000
Annual cost of repairs per mile on gravel roads 5 years old	$400
Miles of improved road (gravel) built in 1905	10
First improved roads built	1879
Proportion of improved roads built since 1895 (per cent.)	10
Satisfaction of farmers with investment in improved roads	Good
Authority	B. F. Carmen, County Auditor

Montgomery County, in the western part of Indiana, is bounded on the north by Tippecanoe County, on the west by Fountain and Parke counties, on the south by Parke and Putnam, and on the east by Hendricks, Boone and Clinton counties. The county is regular in form, extending through townships 17, 18, 19 and 20 north, and ranges 3, 4, 5 and the east half of 6 west.

Sugar Creek, flowing southwesterly through the central portion of the county, drains the greater part into the Wabash. Coal Creek drains the northwestern portion, and Raccoon Creek the southern portions. There is considerable broken country along Sugar Creek, but in general the surface of the county is a gently undulating plain.

Gravel is widely distributed over Montgomery County. There are no great deposits, such as occur in the terraces of the Wabash, but there are large numbers of comparatively small deposits that may be kames or fragments of eskers. Deposits along the streams that may seem to be terraces are in many cases kames that the streams have disclosed and which are the chief source of the sand and gravel in the stream beds. There are many deposits of "water gravel," occupying channels or basins of various depths and covered with more or less soil and clay.

In the southern part of the county there are several outcrops of rock that would probably make valuable road material. Some quarries have been opened, but none were found in operation.

Sugar Creek Township.

This township is in the northeastern part of the county. There is considerable good gravel in the bed of Sugar Creek, which bounds the township for four or five miles on the southeast. E. Russell's gravel bank, on the northwest of the southeast of 34 (20 N., 3 W.), is a large pit in a deposit several acres in extent. As opened the gravel is only about 15 feet thick, but is thought to be much thicker. This pit yields good road material.

In the central portion of the township many pits have been opened in an old esker. William Fisher, on the northeast of the southwest of section 22; Benjamin Stitt, on the northwest of the northwest of 27; Wm. H. Marts, on the northeast of the northeast of 28; Marion Holloway, on the southwest of the northwest of 28; Wm. H. Marts, on the southwest of the northeast of 29, and Mrs. Corbin, on the southeast of the northeast of 29 (20 N., 3 W.), all have gravel pits in the esker, and each has an abundance of good road material. There is a deposit of water gravel on the west half of the northwest quarter of section 34 (20 N., 3 W.), known to be from 30 to 40 feet thick. Its area is not known. In quality the material seems to be good.

Mrs. Betty Bowers, on the northwest of 10, has a deposit of gravel that is 3 or 4 feet down to water, the depth below water level not being known. It is called good road material. Grant Gray, on the southwest of the southeast of section 7, has a large deposit of water gravel. There are from 6 to 8 feet of gravel to water and at least 20 feet below water level. This deposit is also said to yield good road material.

Madison Township.

This township is largely prairie land. Stingley's gravel pit, on the southwest of the northeast of section 11 (20 N., 4 W.), is in a deposit several acres in extent, and shows soil and clay 1 to 3 feet, gravel to water, 8 to 10 feet. The depth below water level is said to be 25 to 30 feet. The material is said to make good roads. Harry C. Shobe, on the northwest of the northwest of section 1, has considerable gravel of a medium quality. The Harrigan pit, on the northwest of the southwest of 17, is in a large deposit, 25 to 30 acres in extent, but the quality is only fair.

The Elijah Bowers pit, on the north half of section 13; that of James Gayley, on the southeast of the southeast of 15, and one belonging to James Booth, on the southwest of the southwest of 22 (20 N., 4 W.), have all been worked down to water level. There seems to be an abundance of good gravel in this region, but no one seems willing to undertake the getting of it out by machinery from below water level.

Coal Creek Township.

This is a large township, six miles north and south by nine miles east and west. Sand and gravel are well distributed, Thomas Cook's bank, on the northwest of section 14 (20 N., 5 W.), is in quite a large deposit, many acres in extent. As opened, this pit shows—

Section of the Cook Bank.

	Feet.
1. Soil and clay	3 to 4
2. Fine sand	3
3. Good gravel	15 to 18

There are a few boulders in this deposit, but the material is of excellent quality, makes good roads and wears well. Thomas Grantham, on the southeast of the southeast of section 3, has a gravel pit in the top of a hill. There are about 18 feet of gravel exposed in the pit, but it is thought to run much deeper. The deposit seems to be four or five acres in extent. It is called good gravel. On the northeast of the southeast of 9 (20 N., 5 W.), in the edge of the town of New Richmond, Mr. H. K. Lee has taken out a great quantity of water gravel. The pit shows 1 to 4 feet of black soil and clay, then 20 feet of gravel in water. The material is rather fine, but is said to make good roads. It is at present extensively used in repairing roads in the vicinity. James Tribby, from his pit on the northeast of 10, furnishes gravel to the railway and to the township.

Clarkson's pit, on the northwest of the southwest of 6 (20 N., 5 W.), is in a deposit of several acres in extent. As opened, it shows—

	Feet.
1. Soil and clay	1 to 3
2. Gravel exposed	15

There is some fine sand and considerable good road material.

The Meharry pit, on the southwest of section 2, and Arthur Evans's pit on the southeast of section 3 (20 N., 6 W.), are in the banks and bed of Coal Creek. They find a good gravel in each locality. Some people in this region consider the stream gravel the best road material.

The Cottrell pit, on the southwest of the southwest of section 15 (20 N., 6 W.), is in water gravel, 20 to 30 feet thick. There are at least three acres of gravel. On the northwest of section 26 there is a great hill of sand and gravel owned by Mr. Lawson. The pit has not been in use for some years. Gravel has been furnished to the township from the following localities: The Dewey place, on the northeast of the southeast of section 2 (20 N., 5 W.); the Beach place, on the southeast of the northwest of 11; the Crane place, on the southeast of the southwest of 23, and the Homell place, on the northeast of the northeast of 13 (20 N., 6 W.); also from the southeast of the southwest of 35, the southeast of the southwest of 22, and the northwest of the southwest of 25, the northeast of the northwest of 29, the northwest of the southeast of 36 (20 N., 5 W.), and from several other tracts of land.

Wayne Township.

Sand and gravel are well distributed over this township, but there are no large deposits, and the gravel is generally only a medium quality of road material. The following named persons have furnished gravel to the township: James Rivers, from the southwest quarter of section 3; Howard Vaughn, from the southeast of 12; James Switzer, from the northwest of the southwest of 32, and Philip Biddle, from the north half of the northwest of 9 (19 N., 5 W.); F. M. Harvey, from the south half of the northeast quarter of section 22; W. H. Munn, from the southeast of 26; Meda Ball, from the southeast of 31 (19 N., 6 W.), and others at different times. In this township but very little creek gravel is used.

Ripley Township.

This township is bounded on the southeast by Sugar Creek, and has considerable broken land along that stream. There is quite a quantity of good gravel within its area.

J. W. Taylor, on the northwest of the northwest of section 8, and Francis Thompson, on the southwest of the southeast of 4 (18 N., 5 W.), have great quantities of excellent road material. Ulysses Wright, on the east half of the east half of 30, has also an abundance of good road material.

James R. Gilkey, on the east half of the northwest quarter of 17, has 30 to 40 acres of good sand and gravel, and there is an abundance of good gravel on the north half of the southwest of 19 and on the northwest of 16 (18 N., 5 W.). This deposit is in the bluff of a little creek and is of considerable depth. Mr. Gilkey says that it is at least 40 feet thick. There is considerable cemented gravel in this deposit. The sand found in it is especially good for concrete work.

Thomas A. Herron, on the southwest of the northeast of section 10; Hannah Dochterman, on the south half of the northwest of 10; N. R. Meyers, on the northeast of 15; F. M. Holman, on the southeast of 35, and Benjamin P. Earl, on the northwest of the northwest of 36 (18 N., 6 W.), each has an abundance of good road material. John Ammerman, on the northeast of the northeast of 26, has a large pit in a deposit of only fair quality. There are only 8 to 10 feet of gravel, and the 3 to 5 feet of soil covering it makes the working difficult.

Union Township.

This township is twelve miles long from north to south and about nine miles wide. The city of Crawfordsville is near its center. The township is well supplied with gravel.

There is a large deposit of sand and gravel near the center of section 28 (19 N., 4 W.). The Vandalia Railway Company opened a large pit in this deposit alongside their road. G. W. Stafford opened a pit along the wagon-road to the east, and William Stitt has two pits in the same deposit which must be at least 40 acres in extent. As exposed in the pits, this gravel is only 18 to 20 feet thick, but it is known to be considerably thicker. This material is of good quality, makes a good road and wears well.

J. R. Carpenter, on the west half of the northwest of 22 (19 N., 4 W.), has 15 to 20 acres of excellent road material. It has been worked to a depth of 30 feet. On the south part of section

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14 there is a great body of sand, with some good gravel. The Vandalia people once opened a pit on this section. Al. B. Smith, George Downing and Ella Flannigan each have pits in this deposit. The material is of good quality, but is mainly sand rather than gravel, and should be screened before using.

J. J. Dauter, on section 36; John Swank, on the east half of the northwest of 23; William Loffland, on the southeast of 7, and James Butcher, on section 5 (19 N., 4 W.), furnished good gravel to the township. Large numbers of gravel deposits in the north part of Union Township seem to be kames or deposits of somewhat similar origin. On sections 1 and 12 (18 N., 4 W.), there is a large body of sand and gravel. Jehu Chadwick, on the southwest quarter of 1; Wm. Stafford, on the southeast of 12, and Otis Stafford, on the northeast of 12 (18 N., 4 W.), have pits in this deposit. The gravel is only 15 to 20 feet thick to shale. There is some fine sand in these pits, but good gravel largely predominates.

Charles Smith, near the center of section 3 (18 N., 4 W.), furnishes large quantities of gravel to the township. Henry Davidson, on the east half of the northeast of 33, has a large pit. It has furnished large quantities of gravel for the last eight years. The deposit is perhaps four acres in extent, and from 10 to 12 feet thick.

J. C. Walters, on the north half of the southwest quarter of 27, has quite a large pit worked down 8 or 10 feet to water. A little to one side in the bed of a small stream a deposit of water gravel was recently discovered. A scoop was installed and gravel is being taken out to a depth of 20 feet. The material seems rather fine for road purposes. There is some medium gravel on the southeast of the southwest of 32, and on the northwest of the southwest of 36 (18 N., 4 W.). Considerable quantities of gravel are taken from the bed of Sugar Creek for use in improving roads. During the year 1904 Union Township paid over 60 different persons for gravel for road improvement.

Franklin Township.

This is township 19 north. Darlington is the chief town. Charles Welvier, on the north half of section 8 (19 N., 3 W.), near the west line of Darlington, has a quantity of good sand and

gravel. As opened, there are about 20 feet of gravel exposed. The deposit probably contains several acres. Clayton Cox, on the southwest of the southwest of 4, has a pit that seems to be about worked out. There may be some gravel below water level.

Miller's pit, on the northwest of 23, is in quite an extensive deposit of very good road material. Several miles of good road have been made from this pit. Mount's pit, on the east half of the southwest of 27, is in a large deposit of fairly good road material.

The Elmore pit on the west half of the northeast quarter of section 33 (19 N., 3 W.), is in a deposit of gravel that has an extent of about three acres. As opened the gravel is about 12 feet thick. The material shows considerable sand, a few rotten stones and some small boulders. It makes a fairly good road but does not wear very well.

On the west half of the northwest quarter of section 34 (19 N., 3 W.), are two gravel hills known as the Castor Mounds. The larger mound is somewhat conical in shape, about 40 feet high and 250 feet in diameter at the base. It seems to be composed of sand and gravel. On its slopes there are several great granite boulders. Just east is another mound or hill of wider area but not more than 25 to 30 feet high. It also seems to be composed of sand and gravel and there are many large boulders upon its slopes.

Walnut Township.

This is township 18 north, and is not very well supplied with gravel. W. W. Ward has five or six acres of gravel on the northwest quarter of the southeast of section 7 (18 N., 3 W.). The pit as opened shows:

		Feet.
1.	Soil and clay	3 to 5
2.	Sand and gravel to shale	12 to 14

The sand is good for plastering and cement work and considerable good road material is present. The Fletcher pit, on the east half of the southwest of 7 and the Lockridge pit on the east half of the southeast of 8, yield an abundance of gravel about the same in quality as that from Ward's pit.

The Bruce pit is on the southeast of the northwest of 14 (18 N., 3 W.). The deposit seems to be several acres in extent and, as

opened, the gravel is about 12 feet thick. There is some water gravel in an adjoining creek bed. In each case the quality seems good, but the material is too fine for good road material, and should be screened before being used. William Miller's pit, on the southwest of section 12 (18 N., 3 W.), as opened, shows:

		Feet.
1.	Soil and clay	3 to 5
2.	Good gravel to water	3 to 10
3.	As tested under water	20

It is not thought to be a very extensive bed. The material contains too much sand for first-class road material, and if used should be screened.

There is some gravel on the northwest quarter of section 24, on the southeast of 12 (18 N., 3 W.), and at other localities in the township. On the southwest of the southwest of 5 John Ward has a deposit of water gravel under from two to five feet of soil and clay. It is thought to be several acres in extent.

Clark Township.

This township is in the southeast portion of the county, and is township 17 north. Ladoga is the chief town. At different places along Raccoon Creek there are extensive deposits of sand and gravel. On the northwest of section 2 (17 N., 3 W.) there is a deposit in which Mr. Standiford has a pit and on the northeast of the same section Mr. Tipton has another. Nothing definite is known as to the extent or depth of this deposit. It must be at least 40 to 50 acres in area and as opened shows about 10 feet of gravel to water. Sand predominates in this deposit, but there is some good road material present.

On the north half of section 3 (17 N., 3 W.) there is an extensive gravel pit opened by the railway on Dan Myers' land. F. W. Baldwin's pit on the west half of the northeast of 9 is also in the valley of Raccoon Creek. In each of these pits the material is abundant and of good quality, but contains too much sand for first-class road material, and should, therefore, be screened before using.

Sam Otterman, on the west half of the northeast of 22, furnishes considerable gravel to the township, which is said to make fairly good roads.

Nathan Hulett, on the northeast of 34, has a large deposit of water gravel. Nothing very definite is known as to its area or depth, but it is thought to be extensive. It is called good material. This township gets some material from Scott Township on the west.

Scott Township.

On the southeast of the southwest of section 13 (17 N., 4 W.) James Knox has perhaps 20 acres of gravel. As opened, the gravel is about 12 feet thick, but is known to run much deeper. On the northwest of the northeast of 24, James Danewood has a large deposit of gravel, much like that of Mr. Knox, on the other side of the creek. In each case the gravel is of good quality.

Albert Goodbar has plenty of gravel on the southwest of the northeast of 27, but the bank has not been opened for several years. David Britt, on the north half of section 26, has an abundance of both bank gravel and stream gravel of good quality. J. W. Foster, on the northwest of 33, also has quantities of stream gravel. On the northeast of the northwest of 5 (17 N., 4 W.) there is a shallow deposit of water gravel about 12 feet deep and of good quality, but rather fine. Good road material is rather scanty in the western part of Scott Township.

Brown Township.

This township is in the southwestern portion of the county. It is drained by Indian Creek and several branches of Raccoon Creek. There is considerable broken land along the streams. The Township is not very well supplied with gravel.

On the northwest of 7 (17 N., 5 W.) Mr. R. Kirkendall has an abundance of good road material. On the southwest of the northwest of 9 Lee Mottens has some good gravel, and Walter Grimes, on the northeast of the southeast of 35, has also quantities of good gravel. The Gorman pit on the west half of the northeast of 15 supplies only a medium grade of gravel. The township gets some gravel from pits to the south in Putnam County. It also uses considerable stream gravel, which many think is very good.

Owing to the scarcity of gravel, Brown Township has tried some stone for roads. On the north half of the northeast of 18 (17 N., 5 W.) a limestone quarry was opened and a crusher installed.

Stone was broken and some road was built. The road is not satisfactory but the fault seems to be in the construction rather than in the material used. The crusher did not run the second year. In the quarry there are several thin layers of hard limestone, but much the greater part is soft, clayey limestone. Doubtless each rock would make a fairly good road, but the harder would wear the better.

On the southeast of the southeast of 34 (17 N., 6 W.) there is another quarry, on the land of J. E. Oldshoe. It was opened and operated for several years by a Terre Haute company. The material produced was used in making roads in the Terre Haute Cemetery. It was also used in South Bend, in New Market, in Waveland, Rockville and other places, giving good satisfaction. The quarry has a face, as opened, of from 25 to 30 feet. There are several different strata that vary in texture and thickness, and the strata vary in different parts of the quarry. A series of specimens designed to represent the average of the quarry were sent to the Laboratory of the U. S. Department of Agriculture for various tests, the results of the physical tests being as follows:

*Results of Physical Tests of Mitchell Limestone from Oldshoe Quarry near Waveland, Montgomery County.**

Specific gravity	2.7	French coefficient of wear	10.2
Weight per cu. ft. (lbs.)	165.3	Hardness	—5.2
Water absorbed per cu. ft. (lbs.)	1.35	Toughness	5
Per cent of wear	3.9	Cementing value—Dry	23
		Wet	43

A chemical analysis of the specimens was made at the same laboratory, with the following results:

Chemical Analysis of Mitchell Limestone from Oldshoe Quarry, near Waveland, Montgomery County.

	Per cent.
Silica (SiO_2)	1.00
Iron oxide (Fe_2O_3)	.50
Lime (CaO)	54.10
Insoluble in hydrochloric acid	2.17
Loss on ignition	42.06
Total	99.83

The quarry was not in operation during the season of 1905.

*For standard of comparison see p. 79.

VERMILLION COUNTY.

Area in square miles	255
Population in 1900	15,252
Miles of public roads	800
Miles of improved roads	300
Percentage of roads improved	37.5
Miles improved with gravel	300
Miles improved with crushed stone	None
Average original cost of gravel roads per mile	$1,800
Total original cost of improved roads	$540,000
Annual cost of repairs per mile on gravel roads 5 years old	$50
Miles improved roads (gravel) built in 1905	20
Proportion of improved roads built since 1895 (per cent.)	20
Satisfaction of farmers with investment in improved roads	Good
Authority	H. T. Payne, County Auditor

Vermillion County is in the central western part of Indiana. It is bounded on the north by Warren County, on the west by Illinois, on the south by Vigo County, and on the east by Parke and Fountain counties, from which it is separated by the Wabash River. The county is about 35 miles long from north to south and has an average width of about seven miles. It consists of extensive flood plains along the Wabash, a wide terrace of sand and gravel and the uplands on the west. The uplands rise to an elevation of about 200 feet above the river. The county is drained by Spring and Jordan creeks, Big and Little Vermillion rivers, and Raccoon, Norton's, Feather and Brouilett's creeks, all flowing into the Wabash River.

The county is divided into five civil townships, viz., Highland Township in the north part, with about 60 miles of gravel road; Eugene Township, with 40 miles of improved roads; Vermillion Township, with 40 miles of gravel road; Helt Township, with 100 miles of gravel road, and Clinton Township, with about 50 miles of improved roads. The gravel deposits of the county are found mainly in the river terraces and along the larger streams.

Northern Portion of the County.

In the northern part of the county a pit has been opened on the Talbot land, in the southeast quarter of the southeast quarter of section 4 (19 N., 9 W.), on the bank of Spring Creek. The deposit seems to be a continuation of beds in the southern part

of Warren County. There are three to eight feet of soil and sand, then 12 to 15 feet of gravel in the pit. Wells in the neighborhood show that the bed of gravel is at least 30 to 40 feet thick. There are several hundred acres of sand and gravel in this region, a large portion of which seems to be gravel. The gravel exposed in the pit was of the first quality.

The next gravel pit south is on the northeast quarter of the southeast quarter of 21 (19 N., 9 W.), on Jacob Doring's land. The deposit is only 3 or 4 acres in extent and is from 15 to 18 feet thick, as shown in the pit. It yields good road material. Gravel from this pit goes north and south and several miles to the west.

Philander Goff has water gravel on the southeast quarter of section 7 (19 N., 9 W.), the gravel being about 10 feet thick to clay. E. Shute, northwest quarter of the southwest quarter of section 16; J. R. Dunlap, southwest quarter of the northwest quarter of section 16, and David Talbot, on the southwest quarter of section 4 (19 N., 9 W.), each have water gravel. The material makes fairly good road, but is rather fine grained.

Considerable gravel for road building has been taken from Coal Creek, a branch of the Big Vermillion. It is said to make a good road, but does not pack as well as that from the pits.

The Hicks gravel pit, on the southwest quarter of the southwest quarter of section 28 (19 N., 9 W.), near Perrysville, yields good gravel and is in a deposit which appears to be several acres in extent. There are also gravel pits on the northeast quarter of section 32, and on section 33, with an abundance of gravel. These pits are near the head of a broad terrace that extends for several miles toward the south, practically to Newport, on the Little Vermillion River.

Buzzard's gravel pit, on the northeast quarter of the southwest quarter of section 5 (18 N., 9 W.), shows 2 or 3 feet of soil and 8 or 10 feet of gravel. The deposit runs much deeper, as shown by wells in the neighborhood. This pit furnishes good road material. There are no gravel pits along the terrace between Buzzard's pit and Eugene, but gravel is abundant, and many miles of road have been improved with gravel from the sides of the road. There is some gravel on James Fleming's place, on section 20 (18 N., 10 W.), in the banks of the Big Vermillion, and there are several

other small deposits along this river. There is also some good gravel in the bed of the stream, but the quantity is small as compared with that in the terrace.

Dr. E. A. Flaugher has a gravel pit on the northeast quarter of the southeast quarter of section 30 (18 N., 9 W.), from which three or four miles of road have been improved.

Vicinity of Eugene and Cayuga.

There is an abundance of gravel about Eugene and Cayuga, especially on the northeast quarter of section 31 (18 N., 9 W), near Eugene, and on the northeast quarter of section 6 and the southeast quarter of section 5 (17 N., 9 W.), south of Cayuga. All of these contain good gravel. In Cayuga, alongside the Clover Leaf Railway, there is a pit. Between Cayuga and Newport, or between the Little and Big Vermillion rivers, there is a broad gravel terrace. Gravel occurs in the banks and bed of the creek on the northwest quarter of the southeast quarter of section 8, and there is a pit near the north line of the northeast quarter of section 17 (17 N., 9 W.). W. H. Dallas has a pit on the northwest quarter of section 16 and Joe Morehead one on the east side of the railway on section 26 (17 N., 9 W.). William Coffa and others have also gravel pits on section 28 of the same township.

Newport, on section 26 (17 N., 9 W.), is underlain with gravel. West of Newport, in the bluffs of Little Vermillion River, on the northwest quarter of section 30, Arthur Betson has an abundance of good gravel. Isaac N. Sager also has a pit on section 31, and Mr. Skidmore has one on the southeast quarter of the northeast quarter of section 29 (17 N., 9 W.). From Newport south to Hillsdale there is practically no gravel along the river, as the flood plain reaches the bluff, cutting out the terrace.

Southern Portion of County.

The Highland gravel pit, on the southeast quarter of section 27 (16 N., 9 W.), and the Alta gravel pit, on the southwest quarter of section 2 (15 N., 9 W.), furnish a good quality of gravel, much of which goes to Dana and other points in the western part of the county. The James pit and Strangs pit, in the central part of section 8 (15 N., 9 W.), on Norton's Creek, yield an abundance

of good gravel. From Alta southward to the county line the terrace is well developed and gravel and sand are abundant. A. L. Mack, on the southeast quarter of section 15 and the northeast quarter of section 22 (15 N., 9 W.), has plenty of good gravel, the deposit being supposed to be at least 90 feet thick. Mr. Stutzman has an extensive gravel pit on the north half of section 23. There are also two pits at Summit Grove, section 26 (15 N., 9 W.), owned by Albert and Charles Miller. The gravel about Summit Grove is especially good for road purposes. It is of good quality and large quantities are composed of grains of uniform size, like beans, and all solid, mainly of granite with some limestone.

John Strain has an extensive sand pit on the north half of section 34 (15 N., 9 W.). The material is especially fine, being nearly pure quartz. There is a gravel pit about the center of section 10 (14 N., 9 W.). In this deposit there is considerable cemented gravel.

The town of Clinton is largely underlain with gravel, and it also is abundant in sections 21, 22, 27 and 34 (14 N., 9 W.). Pits have been opened on the Whitcomb place, section 27, and on the Wm. Morley place, section 34. In general the gravel is of good quality and practically unlimited in quantity. There is some gravel along the bluffs of Brouilett's Creek. The Robertson bank, on the southwest quarter of section 11, and Shew's bank, on the northwest quarter of section 18 (14 N., 9 W.); Stafford's pit, on the southeast quarter of section 15 (14 N., 10 W.), and others furnish a medium quality of gravel, but it is not as abundant as on the terrace farther east.

The roads in the western part of Vermillion County have been built partly from local bank gravel, partly from stream gravel, but largely of material from pits on the terrace. Gideon Jackson has a gravel pit on the northeast quarter of section 15; Benj. Jones one on the northwest quarter of section 11, and J. L. Smith one on the west half of the northeast quarter of section 15 (14 N., 10 W.).

Some roads have been built of slag from the old Indiana blast furnace on the southwest quarter of section 23 (14 N., 10 W.). The slag as a foundation was covered with gravel. Considerable stream gravel is also used for improving roads in the southwestern portion of the county.

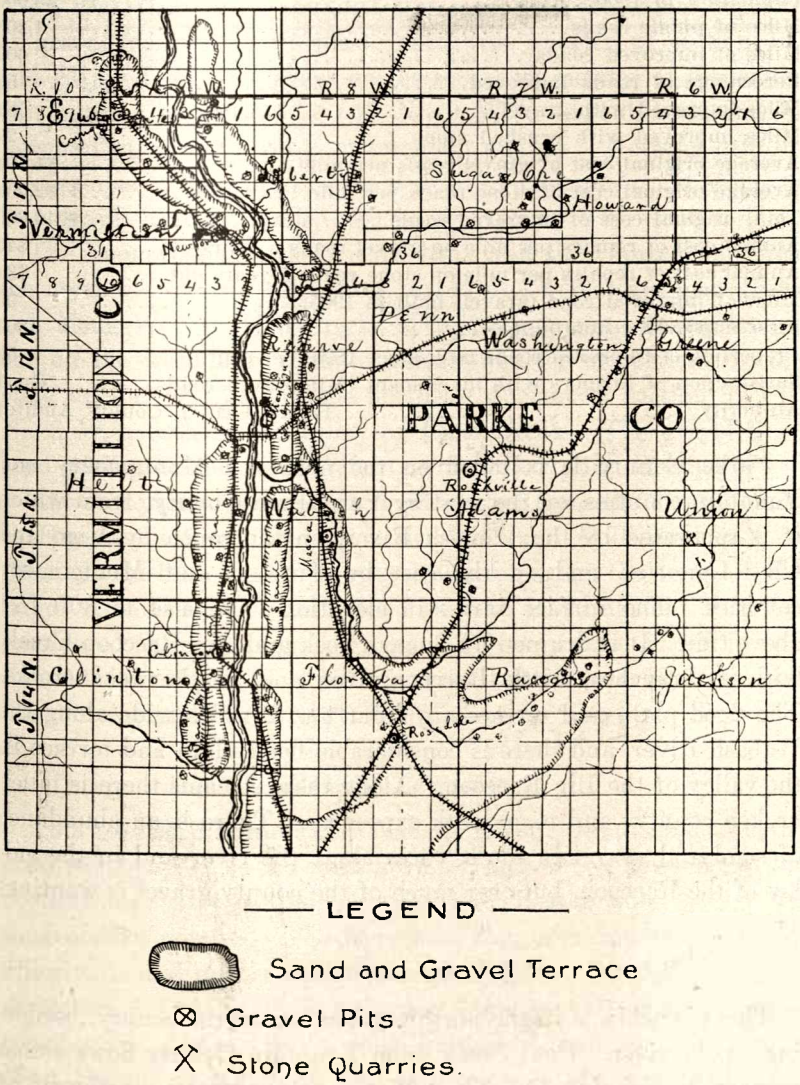

Fig. 42. Illustrating the distribution of road materials in Vermillion and Parke counties.

PARKE COUNTY.

Area in square miles	453
Population in 1900	23,000
Miles of public roads	1,200
Miles of improved roads	600
Percentage of roads improved	50
Miles improved with gravel	580
Miles improved with crushed stone	20
Average original cost of gravel roads per mile	$1,500
Average original cost of stone roads per mile	$2,000
Total original cost of improved roads	$910,000
Annual cost of repairs per mile on gravel roads 5 years old	$40
Annual cost of repairs per mile on stone roads 5 years old	$30
Miles of improved road (gravel) built in 1905	50
First improved roads built	1867
Proportion of improved roads built since 1895 (per cent.)	50
Satisfaction of farmers with investment in improved roads	Good
Authority	Henry Grubb, County Auditor

Parke County is bounded on the north by Montgomery and Fountain counties, on the west by Vermillion County, from which it is separated by the Wabash River, on the south by Vigo and Clay Counties, and on the east by Putnam and Montgomery counties. The surface varies in elevation from 474 to 800 feet above tide. It is drained by Sugar Creek and Big Raccoon Creek, with its branches, Little Raccoon, Iron and Leatherwood creeks. The flood plain and terrace are from 1 to 2 miles wide along the Wabash River, and there is considerable flood plain and terrace in the valley of the Big Raccoon. Along these streams there is much broken country and many rock exposures. There is an abundance of sand and gravel in the terraces along the river and in the valley of the Raccoon, but over much of the county gravel is wanting.

Liberty Township.

This township is in the northwest portion of the county, bordering on the river. Coal Creek from Fountain County flows across sections 1, 2 and 3 (17 N., 9 W.), in the extreme northwest of the township, Wabash Mill Creek flows across the township a little west of the center and Rush Creek drains the central portion. Lodi, on Coal Creek, is situated on a ridge of gravel in section 2, and there is a large deposit owned by D. Shirk on section

3, next to the river. There is here at least 30 to 40 acres of gravel, some of it 40 feet thick to water level. From Lodi southeasterly to Howard, on the southwest quarter of section 18 (17 N., 8 W.), there is an abundance of sand with occasional deposits of gravel, as at Miller's place, northwest quarter of section 12, and Elijah Lewman's place, on the southeast quarter of the southeast quarter of section 13 (17 N., 9 W.). About Lodi and in Lewman's pit the gravel is of excellent quality. Nothing definite is known as to the extent of the deposit at Lewman's. It seems to be a gravel hill surrounded and partly covered with dune sand.

The Leonard bank, the Picard bank and the Church bank, on the northeast quarter of section 18 (17 N., 8 W.) are near Howard, along Wabash Mill Creek. David Commons has two banks, one on the west half of the southeast quarter of section 15, the other on the west half of the northeast quarter of section 22 (17 N., 8 W.), both in the valley of Rush Creek. The gravel is of good quality but not as abundant as about Lodi and Howard.

The east part of the township gets gravel from the Towell bank, in Fountain County, and from the Wolf and Millikan banks, in Penn Township, Parke County. Gravel from the beds of the larger streams is sometimes used in road building, but it is not considered as good as bank gravel. There is some gravel in section 32 (17 N., 8 W.), but in general it is covered deep with boulder clay and can be worked only along the outcrop.

Reserve Township.

This township borders the Wabash River. Montezuma, in the southwestern part, is the chief town. Sugar Creek flows across the northwestern part of the township and Leatherwood across the southeastern portion. The terrace in this township is about 1½ miles wide and deeper than the deepest wells. On the north half of section 6 (16 N., 8 W.) there is some gravel, but it is under considerable clay and is not considered good road material. Near West Union, on the south half of section 7, Mr. Linebarger has opened several gravel pits along the terrace. He claims to have 300 or more acres of sand and gravel, and that he can get good gravel wherever it is convenient to open a pit. Nothing is known about the depth of this deposit. The gravel is of good quality, but

is rather fine and is not considered as good road material as that found farther south in the same terrace.

The Adams pit, on section 19, and the Vestel pit, on the southwest quarter of section 30 (16 N., 8 W.), show abundance of gravel about like that in the Linebarger pits. The C., H. & D. Railway has also a large gravel pit on the west half of section 31. The gravel as exposed in the pit is about 30 feet deep and of good quality. In the north part of Montezuma, on the southwest quarter of the southeast quarter of section 26 (16 N., 9 W.), there is an extensive pit, which yields excellent road material, rather coarser than from other pits in the township. Several other pits have been opened along the terrace. East of this terrace there is practically no gravel.

Wabash Township.

This township corresponds to 15 north, ranges 8 and 9 west. It includes a wide terrace along the Wabash River and considerable terrace land along the Big Raccoon as well. The Pratt pit, on the northeast quarter of the northeast quarter of section 1 (15 N., 9 W.), near the north line of the township, shows good gravel and pits on the northeast quarter of section 12 show fairly good gravel, but farther south the terrace is mainly sand with but little trace of gravel. On the northwest quarter of the northwest quarter of section 7 (15 N., 8 W.), there is plenty of sand or fine gravel, but it does not pack well. As one man says, "it is creepy." George Ussleman, Duncan Puett, Henry Underwood, Peter Pence and others have sand or gravel pits along the terrace south of Armiesburg.

About Mecca, on section 20 (15 N., 8 W.), in the valley of Big Raccoon, there are several pits furnishing good gravel. Among them are the Hixon pit, the Montgomery pit and the Dee pit. North of Mecca there are several pits along the railway, and an abundance of fairly good gravel. South of Mecca, up the creek, there is an abundance of good sand, but no really good road material.

Florida Township.

This township corresponds to township 14 north, ranges 8 and part of 9 west. At Lyford, sections 12 and 13 (14 N., 9 W.), the flood plain reaches the bluff cutting out the terrace. South of

Lyford, on section 23, the "Big Gravel Terrace" begins. On the east half of section 23 (14 N., 9 W.) is located the famous Lyford gravel pit. In the north end of this pit there is a section of fine sand, then a section some 300 feet long of fairly good gravel, in which there are fragments of coal, pieces of shale and sandstone, and large pieces of boulder clay, all apparently local material showing little water action. Mingled with these are quartz sand and granite pebbles, evidently of foreign origin. Beyond this there is an abundance of gravel of excellent quality. There are a few large boulders and some fine sand, but in general the deposit is good road material. There are from 40 to 50 feet of gravel down to water level.

In the southwest part of Florida Township there is an area of about three sections of gravel. There is some gravel and considerable good sand about Rosedale, on section 27 (14 N., 8 W.), but little good road material. There is good sand along the valley of Raccoon Creek, but the only good road material in the township seems to be in the Lyford terrace.

Raccoon Township.

This township, lying east of Florida Township, is wholly in the valley of Big Raccoon Creek. It consists of flood plain, terrace and upland, with considerable coal and shale. Good gravel is abundant. O. A. Cole has a pit on the southwest quarter of section 12; J. N. Miller on the north half of section 14, and J. R. Johns on the southeast quarter of section 15; all in township 14 north, range 7 west. On section 15 the Chicago and Southeastern Railway has a gravel pit in which there are 8 to 10 feet of gravel above ground-water. The quality seems good but the material is rather fine for first-class road material. There is good gravel on sections 21, 28, 29 and 30 (14 N., 7 W.). Not very much is known about the depth of this deposit, but a well drilled in the valley near Rosedale shows 80 feet of sand and gravel to bed rock.

Jackson Township.

This township is in the southeast portion of the county. In the bed and banks of Raccoon Creek there is considerable sand and gravel. Johnson's banks, one on the northeast quarter of section 8

(14 N., 6 W.), and another on the southeast quarter of the northeast quarter of section 7 (14 N., 6 W.), show fairly good gravel, but the deposits are not large, perhaps five or six acres, with 6 to 8 feet of gravel to water level.

In Raccoon Creek, at Mansfield, on the northwest quarter of section 8 (14 N., 6 W.), there is a great mass of good gravel known to be 20 to 25 feet thick. N. Derman, on the southeast quarter of section 7 (14 N., 6 W.), has about 20 acres of good material, 6 to 8 feet thick, situated along the creek bed. Other stream beds furnish some gravel. Elijah White, on the northeast quarter of section 2 (14 N., 6 W.); Milton Murphy and Green Taylor, a little south of White's place, have some good road material. Aside from the stream deposits, Jackson Township is not well supplied with road material.

Union Township.

This is township 15 north, range 6 west. Raccoon Creek flows southerly through the central part of the township. Stout's bank, on the southwest quarter of the southeast quarter of section 10, is several acres in extent and shows 10 to 12 feet of good gravel for road building. About 10 miles of road have been improved from this bank.

F. Nelson and J. S. Shalley, on section 13, have each furnished some gravel to the township. Considerable material has also been taken from the bed of Raccoon Creek and of other streams for use in improving roads.

There are several outcrops of good rock in the township. The lack of good gravel has led to the building of stone roads. John Wilson has a quarry on the southwest quarter of section 21, and William Kinsey one on the southeast quarter of section 28. In the Wilson quarry there are two strata of limestone, one white, about 8 feet thick, the other blue, about 6 feet thick; both hard, the blue stone having the more uniform texture. In the Kinsey quarry the stone appears to be more uniform in color but seems to be softer than that in the Wilson quarry. The rock from these quarries would apparently make a good road material, but the roads made of it are not satisfactory. This is not because the stone was not good, but because the roads were not well graded

and drained, mainly because the township was not able to pay the price of a good road. The poor stone road is, however, very much better than a clay road.

Adams Township.

This township lies between Union and Wabash townships. It is drained by Little Raccoon, Williams and Sunderland creeks. Rockville is the chief town. The improved roads have been built largely of creek gravel. Of the ten persons furnishing gravel to the township in 1904, seven furnished stream gravel. James Ryan has 8 to 10 acres of fairly good gravel on the east half of section 36 (15 N., 8 W.). It is from 12 to 15 feet deep, but rather fine for the best of road material. Guy Alden has some gravel on section 26 (15 N., 8 W.), and Nelson Thompson has a good pit on section 31 (15 N., 7 W.). The larger part of the stream gravel comes from the bed of Little Raccoon Creek.

Penn Township.

This corresponds to township 16 north, range 8 west. Sugar Creek flows across the northwestern corner and Leatherwood flows from east to west across the central portion of the township. Bloomingdale is the chief town.

The Rauch gravel pit, on the northeast quarter of section 35; the Wolf pit, on the southwest quarter of section 25; the Rice pit, on the southeast quarter of section 29, and the Russell pit, on the northwest quarter of section 32, all furnish fairly good road material, and the supply is abundant, but it was impossible to make any definite estimate of the area and depth of gravel in any case. Considerable gravel is taken from the bed of Sugar Creek, and from the bed and banks of Leatherwood Creek, for road improvement. The Kelly gravel pit, on the northeast quarter of section 26, also supplies some good road material.

Washington Township.

This corresponds to township 16 north, range 7 west. Marshall is the chief town. Little Raccoon Creek flows across the southwestern corner of its area. There is no workable bank gravel in

the township. C. K. Huff has some material in the bed and banks of Roaring Creek in section 6.

W. H. Barnes, on the southeast quarter of section 24, and J. C. Buchanan, on the southeast quarter of section 26, get some good gravel from the banks and bed of Little Raccoon Creek. The township gets gravel from John Lusk's bank, in Sugar Creek Township, and some from Howard and Greene townships.

Greene Township.

This is township 16 north, range 6 west. Little Raccoon Creek flows westerly across the northern part of its area, and a creek from Montgomery County comes in from the northeast. Along this creek, in the southeast quarter of section 5 and the northwest quarter of section 8, there is a terrace of sand and gravel. William Jarvis has a gravel pit in each end of this deposit. This deposit has an area of 50 or 60 acres, and varies from 10 to 12 feet to water level. Above the gravel is a soil and clay stripping from 16 to 36 inches in thickness. It is called good road material.

There is some terrace on section 21 along the east fork of Little Raccoon Creek. The Sulton bank and the Peyton bank are in this deposit. It has an area of 25 to 30 acres, and there is 10 to 12 feet of gravel above ground-water. About eight miles of road have been improved from these banks. The material from this deposit makes a good road. Considerable gravel is also taken from the bed and banks of Little Raccoon Creek for road improvement.

Howard Township.

This township borders on Fountain and Montgomery counties. Sugar Creek flows southwesterly across the northern part of its area.

Henry Windle and Sherman Delph each have an abundance of gravel along the banks of Sugar Creek in the western part of the township. William Clore and Henry Litsey, in the southwestern part of the township, furnish good gravel to Howard and Washington townships. Johnson Clore has 12 to 15 acres of good gravel on the banks of Sugar Creek. The gravel is from 30 to 40 feet thick and is easily accessible.

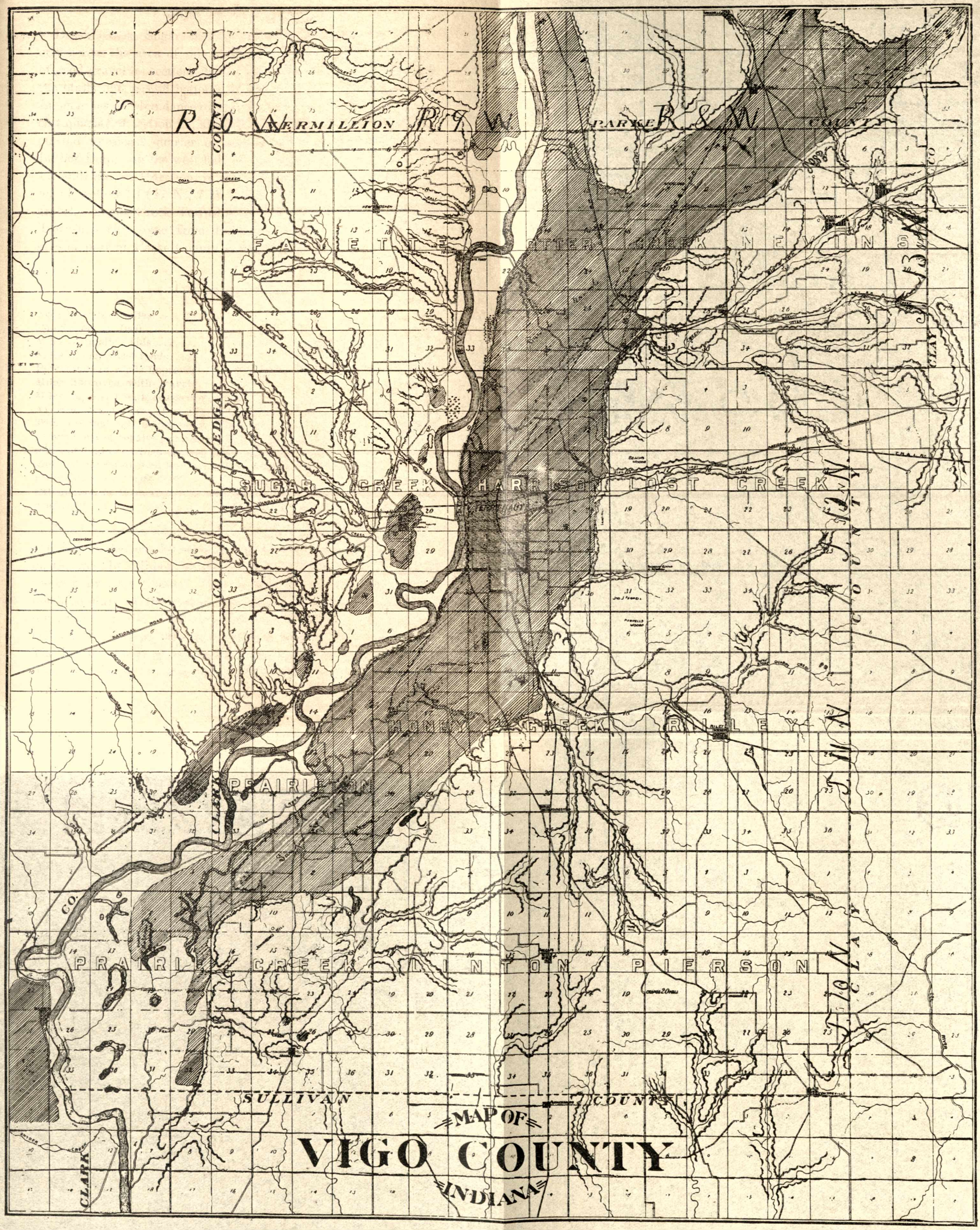

FIG. 42B. ILLUSTRATING THE DISTRIBUTION OF ROAD MATERIALS IN VIGO COUNTY.

Sugar Creek Township.

Brush Creek, Sugar Mill Creek and Green Creek flow southerly across the area of this township. John Lusk has quantities of good gravel on sections 22, 23, 26 and 27 (17 N., 7 W.) along the bluffs and second bottoms of Brush and Sugar creeks. Paul Lungen has an abundance of gravel on the north half of the southeast quarter of section 22, along Brush Creek. George Alexander, on the southeast quarter of section 16, has plenty of gravel. Luther Delph, on the west half of the southeast quarter of section 11, and Marion Harrison, in the west half of the southwest quarter of section 10 (17 N., 7 W.), both have large deposits of good gravel. Sugar Creek Township gets some gravel from Howard Township and some from Fountain County. In general the greater part of Parke County is well supplied with gravel.

VIGO COUNTY.

Area in square miles	402
Population in 1900	62,035
Miles of public roads	725
Miles of improved roads	220
Percentage of roads improved	30.3
Miles improved with gravel	220
Miles improved with crushed stone	None
Average original cost of gravel roads per mile	$1,414
Total original cost of improved roads	$311,187
Annual cost of repairs per mile on gravel roads 5 years old	$180
Miles of improved road (gravel) built in 1905	30
Miles of improved road (gravel) contracted for 1906	16
First improved roads built	1898
Satisfaction of farmers with investment in improved roads	Good
Authority	Jerome W. Denehie, County Auditor

Vigo County is situated on the western boundary of Indiana, and is bounded on the north by Parke and Vermillion counties, on the west by Illinois, on the south by Sullivan County, and on the east by Clay County. The Wabash River flows through the northern part of the county, forming its western boundary in township 10 north. The river valley in the county is four to five miles wide, and its flood plain is from one to four miles wide. The big terrace is on the eastern side of the river and is fully three miles wide. It rises from 60 to 80 feet above low water in

Fairbanks Mem. Library

the north, diminishing toward the south to 15 or 20 feet near the north line of township 10 north. The uplands on either side rise 70 to 80 feet above the terrace.

The principal streams of the county are Spring, Otter, Lost, Honey and Prairie creeks on the east, flowing westerly into the Wabash. On the west in the extreme north is Brouilett's Creek, then Coal and Sugar creeks. There are immense quantities of sand and gravel in the valley of the Wabash. The wells drilled for oil show from 75 to 150 feet of sand and gravel to the bed of the old channel. Vigo County has a bed of sand and gravel 24 miles long and 4 miles wide, averaging 100 feet in thickness. Large portions of this mass are first-class road material.

Area West of the Wabash River.

West Terre Haute, on the southeast quarter of section 19 (12 N., 9 W.), and vicinity, is on a gravel terrace of about 400 acres in extent. The Big Four Railway Company has a gravel pit of about 50 acres on the west half of the northwest quarter of section 20, and the Vandalia Railway Company has a pit of about the same size, mainly on the east half of the northeast quarter of section 19 (12 N., 9 W.). In these pits the gravel has been worked down to water level some 15 to 20 feet, and large quantities have been taken out with dredge and pump from below water level. There is a large gravel pit on the west half of the southwest quarter of section 20, and 2 or 3 on the southeast quarter of section 19 (12 N., 9 W.). This is called good gravel. It is rather coarse in some places, containing many large stones up to 5 inches in diameter. There is also considerable fine sand. The larger pebbles are of different kinds of granite and of limestone, while the finer grains are mainly of quartz. Of 600 gravel stones examined, about 35 per cent. were limestone, the remainder were mainly of different kinds of granite, with a few fragments of geodes. The limestones are usually solid, but they go to pieces under a crushing power that would scarcely affect the granite.

The Vandalia Railway Company are opening a gravel pit on the southeast quarter of section 36 (12 N., 10 W.), where they have about 70 acres of sand and gravel shown to be more than 50 feet thick. The tests show a larger per cent. of sand at a depth of

50 feet than was found nearer the surface. On sections 11, 15, 16 and 21 (11 N., 10 W.), in the southern part of Sugar Creek Township, there are at least 200 acres of gravel from 20 to 30 feet thick. There are no large pits, but gravel has been taken out at 8 or 10 different localities for making and repairing roads. The material is finer than that about West Terre Haute, but it packs well and makes a good road.

There is gravel near the road on the southeast of the northwest of section 17; on the Broadhurst place, north half of the southwest quarter of section 8, and on the Barbour place, on the southeast quarter of section 5 (12 N., 9 W.). These deposits do not seem to be very extensive. There is some gravel along the valley of Sugar Creek, as on the southeast quarter of the northeast quarter of section 23, and on the northwest quarter of the southeast quarter of section 16 (12 N., 10 W.). There is also gravel on the west half of section 31 (12 N., 9 W.).

From section 8 (12 N., 9 W.) northerly along the river, the only deposit of workable gravel found was in the banks of Brouillett's Creek, near the north line of the county. A pit has here been opened on the Guy Briggs place, on the southeast quarter of the northwest quarter of section 4 (13 N., 9 W.). It is in the bank of a little creek, and shows a face of 10 to 15 feet of gravel with 2 to 4 feet of soil and clay. The sand in the pit and in the creek bed appears to be nearly pure quartz. The coarser material is largely of granite and limestone pebbles, with many rotten stones, pieces of coal and shale, and an occasional lump of boulder clay. This deposit extends easterly into the northeast quarter of section 4, and is at least from 6 to 8 acres in extent and of unknown depth. There are also several acres of gravel on Fred Armstrong's place, on the northeast quarter of section 3 (13 N., 9 W.). On the uplands west of the river valley there is practically no bank gravel.

Area East of the Wabash River.

East of the river there is practically no workable gravel in the uplands, and only a few small deposits along some of the streams. Along the bluffs north of Otter, Honey and Prairie creeks there are immense deposits of fine sand and many sand hills that seem to be sand dunes, but they contain no gravel. The sand and

gravel in the big terrace in this part of the county is practically inexhaustible. Only a few good gravel pits have been opened, and those are in the vicinity of Terre Haute. Considerable quantities of good sand and gravel have been taken from the banks and bed of Spring Creek. There is a gravel pit on the northeast quarter of the northwest quarter of section 31 (13 N., 9 W.), and 2 near the railway on the east half of section 13 (13 N., 8 W.). Several other small pits occur in Otter Creek Township, but none of great importance.

In Harrison Township there are three large gravel pits in the south part of section 9, and an abandoned pit across the street on the northeast quarter of section 16 (12 N., 9 W.). There is an abandoned pit along the Big Four Railway in the southwest quarter of section 1, another on the northeast quarter of section 2, and one on the southwest quarter of section 3, in the banks of Lost Creek. The Vandalia Railway has a gravel pit on the southeast quarter of section 14. Other old pits occur on the south half of the northeast quarter of section 26, on the southeast quarter of the southeast quarter of section 27, on the northeast quarter of the northeast quarter of section 34, and on the northeast quarter of the southeast quarter of section 33 (12 N., 9 W.). There is also a pit along the terrace on the northwest quarter of section 33.

The Southern Indiana Railway has a pit along the edge of the terrace on the southeast quarter of section 32 (12 N., 9 W.), extending southerly into the northeast quarter of section 5 (11 N., 9 W.). There is also a large pit on the south half of the southeast quarter of section 35 (12 N., 9 W.), which has supplied gravel for several miles of road on the uplands to the south and east.

Farther south, in Prairieton Township, there is a great body of gravel in the southwest quarter of section 34 and the southeast quarter of section 33 (11 N., 10 W.), and on sections 3, 4 and 9 (10 N., 10 W.). On section 18 and the south part of section 7, same township and range, there is a great mound of gravel, about 100 acres in extent, rising more than 50 feet above low water in the river.

In the valley of Prairie Creek, on the southwest quarter of section 26 (10 N., 10 W.), is the Piety gravel pit, which has furnished material for gravel roads both in Vigo and Sullivan

counties. On the other side of the creek, on the northeast quarter of the northeast quarter of section 27, is the Trueblood gravel pit. There is also a small pit on the southeast quarter of section 29.

The gravel on the east side of the river is generally of excellent quality. The deposit on sections 9 and 16 (12 N., 9 W.) is quite coarse like that in the Railway pits at West Terre Haute. In the other pits the material is of finer grain with very few large pebbles.

CLAY COUNTY.

Area in square miles	357
Population in 1900	34,285
Miles of public roads	800
Miles of improved roads	218
Percentage of roads improved	27.2
Miles improved with gravel	186
Miles improved with crushed stone	32
Average original cost of gravel roads per mile	$2,000
Average original cost of stone roads per mile	$2,500
Total original cost of improved roads	$452,000
Annual cost of repairs per mile on gravel roads 5 years old	$100
Annual cost of repairs per mile on stone roads 5 years old	$100
Miles of improved roads (gravel) built in 1905	8
Miles of improved roads(stone) built in 1905	21
Miles of improved roads (gravel) contracted for 1906	25
First improved roads built	1892
Proportion of improved roads built since 1895 (per cent.)	75
Satisfaction of farmers with investment in improved roads	Good
Authority	Jacob Luther, County Commissioner

Clay County, in the western part of Indiana, is bounded on the north by Parke County, on the west by Vigo and Sullivan counties, on the south by Greene, and on the east by Owen and Putnam counties. It is 30 miles long from north to south and from 10 to 16 miles wide. The northern portion is drained by the branches of Otter Creek into the Wabash, and the southern portion by Eel River and its branches into White River. There is some broken country along the creeks in the northwest, also along Croy's Creek in the southeast, but in general the surface is quite uniform, the general elevation being between 550 and 675 feet above tide. While the surface is generally uniform, drillings for coal and mining operations show that the bed rock has been deeply

eroded and is furrowed by wide, deep channels with intervening ridges.

Prof. G. H. Ashley, in the Report of the State Geologist for 1898, page 520, says: "Some of these hidden channels have been revealed by mining operations or the drill. Thus, near Carbon, section 5 (13 N., 6 W.), three old channels exist, running southwest, one passing a short distance east of the Litchfield shaft, the other two, some 100 feet or so broad, crossing the property of Eureka No. 2 shaft, cutting out the upper coal. South of Carbon drillings are reported to have revealed a broad channel crossing section 7 (13 N., 6 W.), and running south on the top of the hill west of Otter Creek, then still south to the west of Brazil, then turning and passing south to Turner, section 11 (12 N., 7 W.), and going west into Vigo County. In like manner these old valleys have been met in all parts of the county." These preglacial channels often contain deposits of sand and gravel.

Clay County has about 220 miles of improved roads; about 160 miles improved with gravel, 20 miles with broken stone, and about 40 miles with broken stone as a foundation and gravel as a top dressing. The county is divided into 11 townships varying greatly in size.

Dick Johnson Township.

This township lies in the extreme northwest, being a part of township 13 north, range 6 west. The improved roads of this township in the main were built of gravel taken from the Leachman gravel pit on the southeast quarter of section 12 (13 N., 7 W.). This gravel seems to be in a preglacial channel, perhaps the one spoken of by Prof. Ashley as running southerly from Carbon. Mr. Leachman says: "My neighbors, east and west, have coal at the same level I have a bed of sand and gravel." Wells, drillings and mining shafts show the deposit to be at least 100 acres in extent, with a thickness of 10 to 50 feet. This deposit is opened along the bed of a little stream, where the gravel is covered with only from 3 to 5 feet of soil and clay, but outside this valley the soil and clay covering is from 15 to 30 feet thick. In general the water stands about at the surface of the sand and gravel.

Mr. Leachman has installed a pump throwing an eight-inch stream of water, sand and gravel. This material is screened into

two grades, a fine sand and a good gravel of rather small grain. The sand is composed mainly of quartz grains, while the gravel is largely of different kinds of granitic pebbles, with a large number of limestones. This material makes good roads and wears well. In this deposit I found no rotten or disintegrating pebbles, all being of good quality.

There are other deposits of sand and gravel in this township, but like the greater part of the Leachman deposit, the material is covered so deep with soil and clay that it can not be worked with profit. Some gravel is found in the beds of the streams, but it is seldom of good quality, and is not much used.

Van Buren Township.

Van Buren is the northeast township of the county, and includes the greater part of township 13 north, range 6 west. In this township are located the towns of Carbon, Cardonia, Harmony, Knightsville, Benwood and others. The improved roads in this township have been made for the most part of gravel found on sections 8, 10 and 11 (13 N., 6 W.).

The Lamb gravel pit, on the southeast quarter of section 11, about four miles north from Harmony, has supplied most of this gravel. There seems to be a large deposit of good road material in this locality, but I could get no definite idea as to its depth or area. The gravel is somewhat yellowish in color and contains some rotten pebbles, due to oxidation. It makes a fairly good road, but does not wear as long as some other gravels. The pit was not open for use in the season of 1905, and the investigation was therefore not very satisfactory.

The McQueen gravel pit, on the northeast of the southwest of section 10 (13 N., 6 W.), and the Bell gravel pit, on the southeast of the northwest of the same section, are in a deposit of what seems to be a good road material. It is at least 6 to 8 acres in extent and 8 to 15 feet thick. About 5 miles of road have been improved with gravel from these pits. The roads are fairly good and the material wears well. In general, this material is covered with from 3 to 5 feet of soil and clay.

The Charles Orme pit, on the northwest quarter of the northeast quarter of section 8 (13 N., 6 W.), is in a deposit several acres in

extent, and from 3 to 12 feet in thickness. The deposit is opened along the bed of a little stream, where it is covered with from 1 to 3 feet of soil and clay. The pit was opened in August, 1905. Water was reached about 1 foot below the surface of the gravel. A horse-power pump lowered the water about 4 feet, so that about 5 feet of gravel could be worked. The material is a clean gray or bluish gray gravel, becoming lighter when exposed to the sun on the road. As a whole it is rather fine, with more sand than gravel. The larger pebbles are granite and limestone, with occasionally one of quartz, while the sand is mainly of quartz grains. The material seems to be about like that in the Leachman pit, about 3 miles farther west. It packs well and promises much as a road material.

Brazil Township.

Brazil Township is 2½ miles square in the south part of township 13 north, and partly in range 6 and partly in range 7 west. There are no workable gravel deposits in this township. Its roads have been improved mainly with gravel shipped in from West Terre Haute, in Vigo County. Some material for street improvement in the city of Brazil, came from the Summit Grove gravel pits in Vermillion County.

Posey Township.

This corresponds to township 12 north, range 7 west. There is practically no workable gravel in this township and no rock available for road purposes. Some roads have been improved with gravel shipped from West Terre Haute, Vigo County.

Jackson Township.

This corresponds to township 12 north, range 6 west. There is practically no available road material in this township. Some roads in the western part of the township have been improved with gravel from West Terre Haute, while some in the eastern portion were built of gravel from the Trester pit in Putnam County.

Cass Township.

This township, consisting of 12 sections east of the southern portion of Jackson Township, has but little road material. Some

roads were improved with gravel from the Trester pit. Later, some new roads have been built and old ones repaired with gravel taken at various places from the bed of Eel River above Bowling Green.

Washington Township.

This township, south of Jackson and Cass, has some gravel in the beds of Eel River and its tributaries. Some roads were improved with gravel from the Trester pit, but gravel for repair work was taken from the bed of Eel River, while some roads have been improved with river gravel, which seems to be good road material.

Sugar Ridge Township.

This township, lying west of Washington, has no available road material. The sand bars in Eel River along its southern border do not contain good road material. Some roads in this township have been improved with gravel from West Terre Haute.

Perry Township.

This township, adjoining Vigo County in townships 10 and 11 north, has no available road material and practically no improved roads.

Lewis Township.

This is the southwest township of Clay County. There is practically no available gravel in this township. Some roads have been improved with gravel from West Terre Haute. Others have been improved with broken sand rock about 8 inches thick, covered with about 4 inches of gravel, from West Terre Haute. The stone was quarried on Mr. Barrett's farm, section 29 (9 N., 7 W.), and on the Harris land, section 20 (10 N., 7 W.).

Harrison Township.

This township, the southeast portion of Clay County, is 12 miles long from north to south, extending through townships 9 and 10 north. In this area considerable road has been improved with river gravel, which is said to make fairly good road material.

Some roads have been improved with rock and gravel, as follows: Broken sand rock about 6 inches, covered with river gravel about 6 inches. This combination is said to make good roads, but their durability is questionable. The rock for these roads is quarried on the Cooprider place about 2 miles southwest of Clay City.

SULLIVAN COUNTY.

Area in square miles	440
Population in 1900	26,005
Miles of public roads	974
Miles of improved roads	332
Percentage of roads improved	34.1
Miles improved with gravel	272
Miles improved with crushed stone	60
Average original cost of gravel roads per mile	$2,600
Average original cost of stone roads per mile	$3,200
Total original cost of improved roads	$844,623
Annual cost of repairs per mile on gravel roads 5 years old	$50
Miles of improved roads (gravel) built in 1905	22
Miles of improved roads (stone) built in 1905	30
First improved roads built	1895
Satisfaction of farmers with investment in improved roads—	
	"As a rule good"
Authority	E. E. Russell, County Auditor

Sullivan County borders on the Wabash River and is bounded on the north by Vigo County, on the west by Illinois, on the south by Knox County, and on the east by Greene and Clay counties. It is 24 miles in length from north to south and has an average width of about 18 miles. The greater part of the county is drained into the Wabash through Thurman's and Busseron creeks. The southeastern portion of the county drains into White River. The surface is generally level. Some broken country lies along the streams, but the bluffs are not more than from 25 to 75 feet high, and the valleys are wide. About one-fifth of the area is flood plain and terrace.

The Wabash flows along the bluff at Narrows, on section 25 (9 N., 11 W.), and again at Merom, on sections 7 and 18 (8 N., 10 W.), thus cutting the flood plain and terrace into three portions Above Merom they are from one to three miles wide and the terrace is quite sandy. Below Merom they are from 2 to 4 miles wide and the terrace is made up more largely of gravel. There

is sandstone at the Narrows, and at Merom the sandstone bluff is about 170 feet high. Good sandstone outcrops at several places in the county.

Sullivan County has about 250 miles of improved roads and about 80 miles in process of construction. Of the new roads, about 50 miles are being made of stone, the balance of gravel. Some of the stone comes from Thornton, near Chicago, some from Spencer, some from Bedford and some from local quarries. The gravel is, in general, from local pits.

Fairbanks Township.

Fairbanks, the northwestern township of the county, consists of flood plain, terrace and upland. There is an abundance of sand in the terrace, the gravel occurring in isolated localities. The pits furnishing gravel for improving roads in this township are Hunt's pit, on section 6; Bowen's pit, on section 7; Bostick's pit, on the north half of section 19, all in township 9 north, 10 west, and Parker's pit, near the Bostick pit. In addition, some gravel is obtained from the Piety and Trueblood pits, in Vigo County. In general, this gravel is of good quality, but rather fine for first-class road material.

Thurman Township.

This township borders on the river south of Fairbanks. The surface is much as in Fairbanks Township. The pits furnishing gravel for this township are Nowlin's pit, on the northwest quarter of section 23; Gray's pit, on the northeast quarter of section 23, and Monk's pit, on the southeast quarter of the northwest quarter of 14 (8 N., 11 W.). This gravel is said to be very good road material.

Gill Township.

Gill Township borders on the river, but the flood plain is not as wide as in Thurman Township. Below Merom the terrace for some distance is near the river. Roads have been built with gravel from Woods' pit and from the Niles pit, both near Merom Station, on the southeast of the southeast of section 20 (7 N., 10 W.). The Merom Gravel Company's pit, on the south half of section 20, has furnished large quantities of gravel for local use,

and from it large quantities have been shipped. The pits about Merom Station have from 20 to 30 feet of gravel down to water, with very little soil and clay. The deposit extends to the river and the gravel company is pumping gravel from the bed of the river. Considerable gravel has been taken from two pits on the Funk land, on section 10 (6 N., 10 W.). Sand and gravel are abundant in Gill Township, but good road material occurs at irregular intervals.

Haddon Township.

This township is somewhat irregular in form, having only about two and a half miles of river front. The gravel and sand terrace extends from Gill Township across Haddon into Knox County, but the Wolf pit, on section 25 (6 N., 10 W.), is the only one of importance that has been opened in the township. The roads have been made mainly from the Funk pits and the Wolf pit, and of gravel from Emison, in Knox County.

Hamilton Township.

Sullivan, the county seat, is located in this township. There are about 17 miles of gravel and seven miles of stone roads within its bounds. The gravel came from the pits in Gill Township, and from Emison, in Knox County. The stone came from Spencer, Owen County, and from Thornton, near Chicago. There is no gravel and no stone in the township available for roads.

Curry Township.

There is practically no good road material in this township. The roads have been improved mainly with gravel from the Piety pit in Vigo County, while some came from Emison, in Knox County.

Jackson, Cass and Jefferson townships, comprising the eastern portion of Sullivan County, have no available gravel. The gravel used came from Merom Station, in Gill Township, or from Emison. Some stone road has been made of material from Spencer or Thornton. Some native rock has been used, but in general it is not of very good quality.

KNOX COUNTY.

Area in square miles	510
Population in 1900	32,746
Miles of public roads	580
Miles of improved roads	264
Percentage of roads improved	45.5
Miles improved with gravel	200
Miles improved with crushed stone	64
Average original cost of gravel roads per mile	$1,800
Average original cost of stone roads per mile	$2,000
Total original cost of improved roads	$488,000
Miles of improved roads (gravel) built in 1905	35
Miles of improved roads (stone) built in 1905	5
Miles of improved road (gravel) contracted for 1906	40
First improved roads built	1900

Satisfaction of farmers with investment in improved roads—

"Many are of the opinion that better roads should be built for the money, as the cost for repairs is already large, though none of the roads have been built five years."

Authority.....T. H. Adams

Knox County lies south of Sullivan, and is bounded on the west by the Wabash River, and on the south and east by White River. It is very irregular in outline, having an area of about 510 square miles. The surface is generally level or gently undulating, with some broken country in the northeast. Lying between the two rivers, the slopes are short and gentle, so that no large streams occur. Along the rivers the flood plain is from one to three miles wide. Along the Wabash there is considerable gravel terrace, but there is very little gravel in the valley of White River.

A large portion of Knox County was settled before the adoption of the rectangular system of survey, so that a portion of the county is divided into sections, while other portions are divided into surveys and donations, the dividing lines, in most cases, running northeast-southwest and northwest-southeast, though in some cases they are irregular.

Busseron Township.

This township is in the northwest part of the county. There is a great body of sand and gravel in its area, the sand largely predominating. Gravel occurs in workable quantities on sections

11, 12, 13, 14, 23, 24, 25, 26, 35 and 36 (4 N., 10 W.), and on donation 210 between sections 13 and 24; also on sections 2, 11 and 13, and on donations 204, 205, 209, 211, and on other land along the ditch and railway in township 3 north, range 10 west.

On donation 204 the Terre Haute & Evansville Railway Company have a large gravel pit. The A. Pfafflin Gravel Company are working the pit. They pump the material and screen it to suit the purchaser. They can furnish from 300 to 350 cubic yards of screened gravel per day. As ordinarily screened, about half the deposit is sand, which is of excellent quality, being nearly pure quartz. The screened material consists mainly of granite and limestone pebbles, and has a good reputation as a road material.

Several pits of small size have been opened on the tracts of land mentioned above, for local purposes, but none are of much importance. The railway pit is about two miles southerly from Emison, and the gravel is generally known as Emison gravel. Dr. Orman's pit, Purcell's pit and the Grand Crossing pit are located two to three miles west and north of Emison.

Washington Township.

This township has a frontage of about two and a half miles on the river and extends easterly about eight miles. There is some flood plain along the river and a little terrace material, but in general the surface is clay. There is practically no gravel nor stone in the township available for road making. The improved roads within its bounds are made of gravel from the railway pit, near Emison.

Vincennes Township.

This township is about 14 miles long from north to south, including all of townships 2 and 3 north, with about two miles of township 1. It has a river frontage of at least 25 miles. In the north the rock bluff at old Fort Knox is washed by the river, and for a mile or so there is no flood plain nor terrace.

Three and a half miles south of the "Old Fort" is the city of Vincennes. It stands on a terrace of sand and gravel that, in the north, rises from 30 to 40 feet above low water, diminishing in elevation toward the south. Gravel is abundant. Lanahan &

O'Donnel have a large pit in the edge of the terrace on the west, where there is 20 to 25 feet of gravel down to ground water. This company has another pit in the north part of the city, near the edge of the terrace, and the city of Vincennes has a gravel pit in the same neighborhood. O'Donnel has two pits near the railway south of the city. One of these Mr. O'Donnel calls a sand pit, the sand making up four parts and the gravel one part. The other, which he calls a gravel pit, is composed of four parts gravel and sand one part. The material is much alike in these pits. The sand is nearly pure quartz and good for plastering or concrete work, while the coarser material makes good roads. The O'Donnel gravel pit shows from 6 to 8 feet of gravel to water, and he has pumped the material to a depth of 17 feet below water level. At least ten miles of road have been built from this pit, besides large quantities of gravel that have been used for improving the streets of the city. There is a gravel pit near the coal mine in the eastern part of the city, and others in the south in the neighborhood of O'Donnel's pit.

South of Vincennes, along the terrace, there are several small gravel pits. These are the Brevoort pit, the Whitehead pit, owned by the township, and the Vieke pit, about five miles south of the city. The county also has a pit on the Dicksbury road, about two miles south of the city. The township is well supplied with gravel, but there is not much improved road south of the city.

Decker Township.

This township is in the southwestern part of the county. It has the Wabash on the west and White River on the south and east. There is considerable sand and gravel in the township, but no pits of importance have been opened. Practically no roads in this township have been improved with either gravel or stone.

Johnson Township.

This township lies south and east of Vincennes Township. In general it has quite a uniform surface. There is plenty of sand and clay, but no gravel or stone that is available for road building. The roads in contemplation are to be built of imported gravel.

Harrison Township.

This township is in the southeastern portion of the county. It has no bank gravel and no available stone for road building. There is some gravel in sand bars along the river, but it is not called good road material. There are practically no improved roads in this township.

Palmyra Township.

This township lies east of the northern part of Vincennes Township. It has no gravel and no stone available for road building. The improved roads in its area have been made of gravel from Emison or from Illinois, brought in by the B. & O. S. W. Railway.

Steen Township.

This township, lying east of Palmyra, has no good road material except what may be found in sand bars along White River. Some roads have been improved with gravel from Emison or from Illinois.

Vigo Township.

This township extends from Steen northeasterly along the river to the north line of the county. It has about 35 miles of road improved with stone, mainly from Spencer, Owen County, quarries. About three miles of road were improved with stone from local quarries. The quality of the latter appears to be good, but the beds are thin and the stripping heavy, so that it probably can not be worked at a profit. There is no gravel except a little in the river sand bars.

Weidner Township.

This township lies along the north line of the county, between Busseron and Vigo townships. There is practically no gravel within its area. It has 22 miles of road improved with broken stone. About ten miles were improved with stone from local quarries, and the balance with imported stone.

The most extensive local quarry is on section 21 (4 N., 8 W.), owned by Gustave Stoelting, a section of which shows—

Section of Quarry on Stoelting Farm.

		Feet.
1.	Soil and clay	3 to 6
2.	Shale rock	2
3.	Hard limestone	4

The limestone makes good road material, but, as worked, it costs more than imported stone. There are several outcrops of this rock in the township, but in no case does it occur in such form as to promise that it might be quarried with profit.